The Small Computer Magazine

kilobaud T.M.

Understandable for beginners . . . interesting for experts

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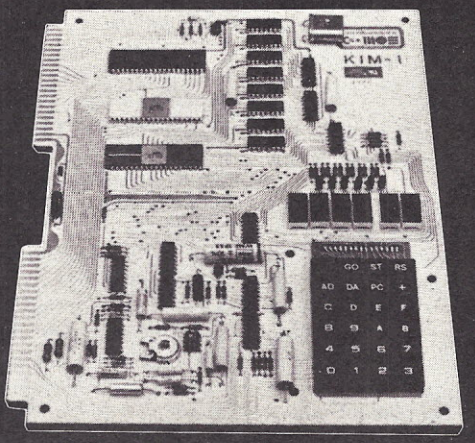

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PUBLISHER'S REMARKS

Wayne Green

The French Do It Again

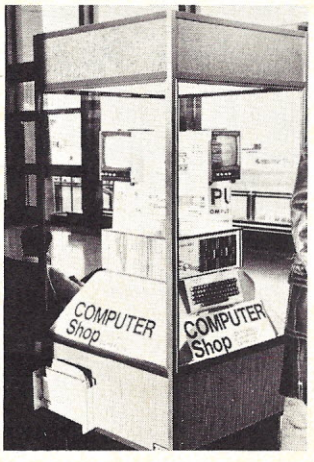
A letter from W3NET included a reference from a navy-published book, and it covers the history of Teletype codes. The upshot of all this is that the five-level code we've been using all these years is not Baudot at all . . . it is the Murray code, developed by Donald Murray around 1901. The Baudot code is entirely different . . . though still a five-unit code. For instance, in case you don't want to believe me, the letter R in Murray is 2 & 4. In Baudot, R is 3. In Murray code, the uppercase R is the number 4. In Baudot, uppercase R is a hyphen. Convinced? Murray code is also known as the International Telegraph Alphabet No. 2.

It's time to change to ASCII and bury this whole mess.

Spadework

There it was! Right by the ramp leading to the United Airlines plane at Logan (Boston) I saw this kiosk with a PolyMorphic microcomputer . . . all set up and running. It was put there by the Computer Shop of Cambridge and must have cost a bundle. I hope it draws some business for them.

Just to be sure, I called Bob Rivers at the Computer Shop and asked him how effective the kiosk was. That's awfully expensive advertising, so it would have to pull a lot of customers to be worth the expense. Bob said that they had renewed their contract for the space, if that told me anything. It sure did.



When we were pricing displays for promoting Computermania, we checked on the cost of the billboards at the airport . . . hoot mon! They cost a couple hundred dollars a month each . . . just for the billboards . . . so I'm afraid to even speculate what a kiosk like that runs.

It's located where every passenger has to go right past it, so the visibility is high. There are some brochures available to help people remember the name and address of the store . . . and a rough outline of what they are selling. This is tremendous promotion for microcomputing.

The airline magazines are running a special computer section in June, so keep your eyes open if you are traveling to NCC or the Atlanta Hamfest/Computerfest.

The Second Faire

The San Jose Computer Faire was enjoyed by just about everyone. It was packed with people and there were many more prospective exhibitors than space for exhibits.

Many exhibitors mentioned that there seemed to be a lot less room than there had been last year at San Francisco . . . room for fewer exhibits . . . and tiny aisles which quickly filled up, making it very difficult to get around.

A check with a Convention Facilities Directory showed us that San Francisco had 37,000 square feet in the main room and 30,000 more in the two side rooms, for a total of 67,000 square feet. The San Jose hall had only 30,000 square feet . . . plus about 2000 more for the microbooths in a separate room. No wonder it seemed so crowded . . . it was half the size of the San Francisco Civic Auditorium.

A rough calculation of the aisle space showed about 11,000 square feet. When a density of one person per ten square feet is reached, an exhibit hall is generally considered full, and it is difficult for people to move around. This leaves room for elbows and a bag of literature, but not much more. At times the show reached this density in the more popular spots, indicating a possible head count of 1100 in the aisles.

That may seem a bit scant in view of the interesting numbers announced by the Chairwhatever, but I like to check little nit-picking items like this, so every so often I would take a quick run down a few aisles, counting the feet and dividing by two. There were seven aisles in all, with four of them shortened by the cut-off corners of the hall. This shortening just about made up for the space in the three cross aisles. My counts confirmed the approximately 1000 attendance figure during the more crowded times.

When the crowd density gets to five square feet per person, there is no longer room for elbows or much arm movement, and shuffling around is quite difficult; and this could account for a total of up to 2200 people in the exhibit aisles.

With 150 exhibits to see and a total of 1500 minutes of show time, maximum, no one could spend more than an average of ten minutes per booth and see the whole show. The attendance was scant on both Friday and Sunday mornings, so very few people managed to get in the entire 1500 minutes. The familiarity of the faces by Sunday indicated that a lot of people did come all three days and made an effort to see all of the exhibits.

Each person who got anywhere near the *Kilobaud* booth was asked to fill out a questionnaire which would be entered in a drawing for a Caribbean cruise. Few passed up the opportunity. By Sunday we found that most of the passersby had already filled in a card, indicating a high percentage of show-goers coming back for a second and third day to see the exhibits.

Though it's possible that a few people managed to see the show and not get near the *Kilobaud* booth, this is unlikely. Our count on the filled-out cards, after sorting out the duplicates (some people try to increase the odds on these things), came to 4100.

A check with several exhibitors who were handing out literature indicated that some had handed out over 3000 pieces . . . others claimed close to 5000.

Software Needed

I don't think there was one manufacturer or dealer who didn't express the universal cry for programs. Hobbyists have been spending a lot of money on hardware, but so far there has been very little they could do with their expensive systems except play Star Trek, Submarine, Mastermind and so forth.

The *Kilobaud* plan for distributing software was enthusiastically embraced by everyone . . . now all we have to do is get it going. We do have the staff and the equipment to get this project running, so I hope the first programs will be coming out in the next few months. Programs for the TRS-80 and PET will be out on cassettes. We have a first-rate lab for checking out programs, a superb cassette duplication system for bulk production of cassettes, the publishing facilities for printing documentation, the sales force and list of dealers to distribute and an international rep organization to get us into every country.

Programmers can do a lot worse than get in touch with *Kilobaud* about publication and distribution of their programs. They must be complete and ready to go, with thorough documentation. The deal is simple: 20 percent royalty on our receipts. This is about five times the going rate, and we hope that we can establish this as a norm for this field by starting it out that way and maintaining this percentage.

What kind of programs are needed? Just about anything for the TRS-80 can be instantly distributed. At present the programs should fit the 4K systems, but it won't be long before we'll be needing most programs to work with the 16K systems. Almost anything will go for the PET too . . . 8K systems.

In the long run we will be able to do best for programmers who work on what we call vertical systems. These would be program packages that would enable computer stores to sell complete systems to specific businesses. Let's say a programmer has a good friend who runs a moving-van service. I picked that at random by opening the Yellow Pages. He would then consult with his moving friend and develop a program package that would do everything a moving-van firm could want . . . everything.

Once the package was done and carefully checked with a couple local van firms for accuracy and completeness, we would

package it and sell it through computer stores. Stores would take the package, set it up to work on a system and then call van firms to come in and see it at work. It is unlikely that many would pass up the system. When you consider that there are over 80,000 such firms around the country, you can see that sales could be vigorous.

There are hundreds of vertical packages that can be developed to help computer stores with their sales . . . and these should bring in handsome royalties.

Next we come to computer-aided instruction . . . and the possibilities for thousands of more programs. Every course taught in school—and those that should be taught in school—are good prospects for this field.

Home-oriented programs will be popular . . . security programs, general business programs, games . . . the list is, fortunately, endless.

Programs that are usable on more than one system will be checked out on other systems in the *Kilobaud* labs . . . we have most of the microcomputer systems set up for this . . . and even our maintenance man is into working up programs. Of course we have the TRS-80 (16K), the PET, Altairs, Imsai, OSI, ISC, Heath H8 and H11, etc. This place is microcomputer heaven.

Programmers should send in complete listings, documentation, some data on how to use the programs and what they can do . . . plus a cassette or disk with the program on it, depending on the system. We would like to get as good a print of the program as possible.

Programmers interested in tackling a major programming package would do well to register with us. This could prevent ten programmers from working up very similar dental programs, for example. Tell us what you are planning to put together and we'll let you know if anyone else is working on something similar. Packages will be chosen on the basis of excellence, not first come.

Very Rich Programmers

We feel it is in the interests of the whole industry that programmers get a major piece of the action. The ability to sell microcomputer systems rests on the excellence of the programs . . . more so than the hardware . . . so why not make it possible for programmers to benefit accordingly? Our system should make it possible for programmers to get rich beyond their wildest dreams.

Suppose we come up with a hot moving-van package . . . and sell it for $995 to the customer. This would wholesale to the dealer for $597 (40 percent off). The rep would get 10 percent, leaving a net sale of $537.30. Twenty percent of that would come to $107.46. If only 10 percent of the van firms bought the system, this would net the programmer $859,680 (before taxes). I suspect that sales will be more like 75 percent of the industry than 10 percent, but why build the pie factory in the sky? A 75 percent sale would bring in about $6.5 million in royalties.

Is $995 a little high for such a package? The customer would be buying about $15,000 or so in hardware to go along with it, so it would really be miniscule . . . running less than $25 a month!

What about my plan for $7.95 software? Oh, we'll have a lot of that. The programs for games, for homes, general programs, teaching programs, these will be of interest to much wider interest groups, and we can look for sales in the millions of these programs. Most of the TRS-80 and PET programs will come in this category . . . at least until the hardware is available for business use of these systems.

Are you still reading and not rushing to your computer to program? You need some All-Bran . . . badly.

The *Kilobaud* Lab

As soon as the TRS-80 and PET are brought into the system we'll have one of the most extensive microcomputing systems anywhere. On line at present are two Altairs, an Imsai, an Ohio Scientific Challenger, a Heath H8, an H11 and five Compucolors. Peripherals on line are a Centronics 51 printer, a G.E. Terminet, a Teletype, an OSI disk, two Altair disks, a North Star disk, the H10 and H9, the SWTP CT-64, a Computalker, a clock module, the Heuristics board, an S.D. Sales Z-80 etc.

Barry, our tech, is working to I/O all of this to our Prime minicomputer system as well as the TRS-80 and PET. This will enable us to check out submitted programs on just about everything popularly available . . . lacking only a 6800 system.

In addition to our wanting to know personally how all the various systems work, another reason for all this hardware is to give us the ability to produce programs for sale . . . and be sure they all work on the systems we say they will.

What's Coming?

Initially we'll be putting out programs on cassettes. After that we'll probably be using more and more disks, then perhaps ROMs; but what will be next?

With the prices on video recording systems coming down, we may soon see video recorders used for program and data storage. These recorders are all set up to be easily controlled by a computer.

Picture, if you will, a study course of the future . . .on videotape. It will have full television action and sound in color . . . and program your computer as it goes along. It will show material and then stop and ask a question about what has been

Reader Responsibility

One of your responsibilities, as a reader of *Kilobaud*, is to aid and abet the increasing of circulation and advertising, both of which will bring you the same benefit: a larger and even better magazine. You can help by encouraging your friends to subscribe to *Kilobaud*. Remember that subscriptions are guaranteed—money back if not delighted, so no one can lose. You can also help by tearing out one of the cards just inside the back cover and circling the replies you'd like to see: catalogs, spec sheets, etc. Advertisers put a lot of trust in these reader requests for information. To make it even more worth your while to send in the card, a drawing will be held each month and the winner will get a lifetime subscription to *Kilobaud*!

Reader-service card submission is on the increase, so we had plenty to draw from. Winner of a lifetime subscription to *Kilobaud* is Fred Schild of Playa Del Rey CA. Congratulations, Fred.

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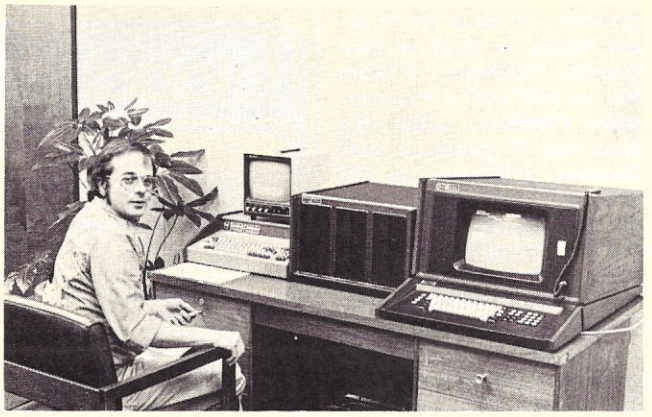


This is the latest Extensys system. It is approaching the top end in performance microcomputers . . . and it isn't cheap, either. This is an excellent example of how far things have gone with micros.

Here's a view of the main part of the PET production department. The front line is brand new PETs that are being checked out with diagnostic programs to make sure they work.

On the right of the PETs being checked out is rack upon rack of PETs being burned in. They burn 'em in for 48 hours before packing them up for shipment. Normally they have those plastic covers over the burn-in racks to make sure that the PETs are hot, thus aggravating any troubles that might otherwise turn up later.

shown. If your answer is right it will compliment you and then go on with more instructions. If you goof, the tape will rewind and replay the part you screwed up.

How far in the future is all this? Jolt had just such a system up and running two years ago . . . using a Sony video system and Jolt microcomputer. Prices on video recorder systems are coming down; performance and availability are going up. These would seem ideal mates to our computer systems. And think of the data storage on a video cassette!

Jolt was recently bought out by MOS Technology (Commodore), so we may see some of this technology coming along sooner than we think . . . if Commodore lets the Jolt crew have a free hand.

Speaking of the PET

After the Faire, Sherry and I stayed over a couple of days in the San Jose area. We made a visit to Extensys and then went over to Commodore to see the plant where the PET is being produced. Commodore doesn't want me to spill the beans on how many units they are turning out, but I'm sure you will be able to get a good idea from my photos. They have a big bunch of units going through the production line and then through exhaustive testing. The PETs are burned in for 48 hours at a very high temperature in order to bring on any possible failures before shipment rather than after. The small number of sets in for repairs indicates the quality control system is working very well.

How long does it take to put together a PET? From one end of the production line to the test bench it takes a little over one hour! With the large number of PETs coming out of the factory it is amazing that dealers are groaning over their back orders . . . some were telling us they could sell ten times as many as they are able to get.

The factory will be increasing its production soon, but this still won't take the pressure off. By next year, I'll bet they have a factory several times as large as they have right now.

What about Radio Shack?

On the way back from San Jose we stopped off in Dallas/Fort Worth.

The next day we had lunch with Bill Mueller of ICOM and Art Housholder of AGL Electronics in Dallas. A Mexican restaurant right near AGL was fantastic. I don't care if AGL wants to throw away their advertising money like drunken sailors in other magazines, I'll be stopping by to visit at every opportunity.

From there we waddled on to Radio Shack and Hy Siegel. Despite a broken leg, gained a few weeks earlier on the ice-skating rink in the center of the Tandy building shopping plaza, Hy took us all over the new Tandy headquarters building.

A few blocks away there is an enormous parking lot, serviced by a new subway system that ends in the Tandy building. This permits people to park and shop the downtown area . . . and get to the parking lot easily. The ground floor ice-skating rink is ringed by a shopping plaza. Prominent in the plaza were a giant Radio Shack store, a Tandy Computer store and a new Tandy Telephone store.

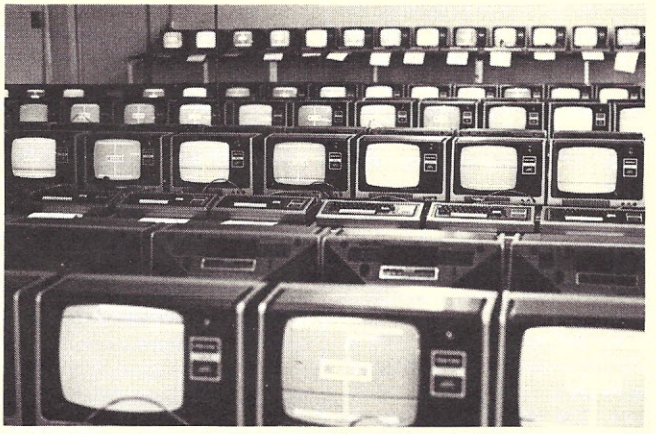
The elevators go up to the 17th floor; from there you have to take an escalator to the top corporate offices.

While some firms are being run by uptight people who appear to be well on their way to terminal constipation, the Radio Shack crowd seems to be having a good time at their work. I was surprised at the large number of hams involved in the higher positions . . . most of whom have been reading *73* for years. I like that in a person. I've known many of the people either through Radio Shack in Boston or Allied Radio. Quite a crew!

Tandy has built two tower buildings recently . . . both about 19 floors. They have a third tower going up soon . . . 45 floors. Tandy is dominating downtown Fort Worth. Some difference from when I lived in the area about 30 years earlier and the highest point in town was the dung heap at the stockyards.

After the visit to the offices . . . some talking with various departments about prospective microcomputer growth . . . my software plans, etc., Hy took us off to the plant not far away where the TRS-80s are being made. Wow! Again, no production figures were to be let out of the bag, but you can see from my pictures that the production is not insignificant. They run the systems in for 24 hours, so you know all the sets you can see are just a part of one day's production.

It was so difficult to tear myself



Here are over 100 TRS-80s being burned in . . . and this is just one part of the burn-in area . . . which goes on and on . . . and on. If anyone tries to tell you Radio Shack isn't making a lot of 80s in Ft. Worth, tell him baloney.

EDITOR'S REMARKS

John Craig

away from the factory that we almost missed our plane back to Boston . . . and home.

TRS-80—Is It Any Good?

I've had letters from hundreds of TRS-80 owners . . . and talked with dozens at the recent shows, but I haven't had any negative comments yet on the system. Oh, everyone wants more memory and bigger BASIC, but they are amazed at what the 80 can do with what it has—and they are having a ball with it.

In view of this, the recent blast in PCC at the 80 is a mystery. The people at Radio Shack were numbed by the negative review . . . and as bewildered as I by it. Yes, the case for the keyboard and CPU is plastic, but it is very attractive and it resists dings a lot better than metal; and if you want to carry the system around the way most of us do, you loudly hail the use of lightweight plastic instead of boat-anchor iron. I carried my TRS-80 with me to San Jose . . . on to Dallas and back home. I sure wouldn't have done that if it had been in a metal case. What other computer system can you throw in a suitcase and take with you?

Byting the Apple

Since they were giving out free copies of *Byte* at San Jose, I stuck a copy in my flight bag to bring back. The price was just right.

On the flight, I had the choice of sitting back and resting or reading the magazine. I made the wrong choice and soon got a mental hernia over a review of the Apple II by editor Helmers.

Before reading the Helmers view of the Apple, I had the impression that it was an excellent system. Many of the computer store owners I have talked with were very enthusiastic about it, and it seemed to be one of the best selling systems on the market . . . possibly giving Radio Shack and Commodore a run for their money. The reader comments in the letters had all been very positive, so I was unprepared for the vicious attack in *Byte*.

Helmers, who, I understand, got the Apple free, may provide an object lesson for manufacturers who are feeling generous. He apparently could see no good in the contrivance. He didn't like

(continued on page 106)

Who Reads *Kilobaud* Magazine?

We not only have a reputation for being a magazine for "beginners" in this field—we flaunt it! I think we need to sit back and examine just who these "beginners" are, however. It's really very simple . . . we're all beginners to one degree or another. The person who just developed an interest in building or using a personal computer, and hasn't any background, is most definitely a *beginner*. (And speaking of that type of person: I recently heard of a company that didn't feel they should be advertising in *Kilobaud* because of this "beginners' magazine" image. What a hogwash attitude! Are they going to totally ignore that ever-increasing segment of the market?)

Those "total novice" individuals need to be examined much more closely because they're coming from several different directions and have different objectives in mind. *Kilobaud*, and every other magazine in the personal-computing field, is being bought primarily by computer *hobbyists*. Some of those other magazines purport to be aimed at the mass market . . . those millions of average middle-class Americans who will be buying home systems in the years to come.

The key phrase there is "will be buying." That market hasn't arrived yet, but it will—and, needless to say, we've all got our eye on it. But for right now (approaching the middle of 1978), *Kilobaud* is providing a lot of material for this mass market.

I've come to this conclusion as the result of recently teaching a couple of one-day courses on personal computing for the University of California. At the beginning of both courses, I opened with the comment that even though I was the editor of a computer-hobbyist magazine, I had no intention of directing myself to computer hobbyists. Those in attendance included newcomers interested in home computers, students, professional people (some in data processing) and small businessmen. I was rather amazed at the number of times I made reference to articles in *Kilobaud* that would be of interest to those people.

These two groups were made up of end users, or the mass market, we've been talking about. If you stop and think about some of the practical applications programs we've run, hardware and software reviews, and small-business software, I think you'll see what I mean.

Many see this new mass market as being made up of people who simply want to take their new computer system home, plug it in, load a cassette program and run! I agree with that concept . . . to a point. That point is where these people begin to tire of all the "canned" programs they can buy . . . and get the itch to generate some of their own. (That's not hard to imagine because many of the younger generation will be programming the home computer to solve homework problems, and thereby exposing mom and dad to programming.) There will be another segment of these end users (most likely those with an electronics background) who will start tinkering with the system by adding new peripherals, modifications and capabilities.

Aha! You know what we're going to have then? More computer *hobbyists*! I wonder what magazine they'll be buying when they go down to their local computer stores?

Now . . . what about some of the other "beginners" reading *Kilobaud*? I hope computer stores, and readers, are directing small businessmen (under 5' 5") shopping for a system toward *Kilobaud*. We're doing our best to provide material to help them in selecting a system . . . with articles written with them in mind.

Now we get to the best part: all those professional computer engineers and programmers out there who read *Kilobaud*. You know, there really aren't that many people out there who are *experts* in every single area of this field. To put it quite simply, there are a lot of software types who are interested in expanding their knowledge in the hardware area . . . and probably even more engineers interested in picking up on programming techniques. Those people are, of course, interested in reading *Kilobaud* for the same reason as anyone else: articles of general interest, objective hardware and software reviews, and *the ads*.

A good friend of mine recently pointed out something about *Byte* and *Kilobaud* that gave me some food for thought. He held up a copy of one of the two magazines and said, "This magazine is almost exclusively filled with esoteric, high-level articles and very little in the way of light reading material."

Picking up the other one, he said, "Then we have this one, which is filled each month with *mostly* light reading, short articles . . . and very little that you can really sink your teeth into. Two magazines: one which is too technical in content, and the other too light." He suggested that since *Kilobaud*, rather than *Byte*, could more likely balance things out, I should consider including at least one or two "heavy" articles in each month's issue. I'm inclined to agree with him . . . what about you? (Heck, this business of putting together a magazine is a snap! All you have to do is provide material that will satisfy tens of thousands of readers . . . all with varying interests!)

The Southern California Swap Meet

Got anything scheduled for July 1st? If so, get busy and cancel it . . . and don't plan to go out of town for the July 4th weekend . . . that is, if you live in Santa Barbara CA. If you don't . . . then, by all means, plan to drive there for the Southern California Swap Meet on July 1st. People will be coming from as far east as Phoenix . . . as far north as San Francisco . . . and as far south as San Diego . . . so there's no reason for *you* not to come!

Next month I'll include a map showing how to get to it . . . and a photo of the beautiful building the event will be held in. And, that's what it's going to be—an event: computer hobbyists, hams and electronics experimenters all getting together for a good time; and, without a doubt, that is the most important part.

Admission will be free . . . for buyers. Sellers can drop me a line

(continued on page 110)

AROUND THE INDUSTRY

John Craig

The following is from an official bulletin issued by the Santa Maria CA Police Department.

The DataSync Corp. was started in early 1977 by Colonel David Winthrop and advertised extensively in the national computer magazines. In late June 1977, Santa Maria CA Police detectives learned that Colonel Winthrop had used other names and had obtained driver's licenses under at least three names. Police learned that the Colonel had defrauded a Santa Maria man of $10,000 under the pretense of designing a computer board for him, and detectives obtained an arrest warrant for Winthrop along with search warrants for his home and his business. Winthrop was arrested at his business and was held under $100,000 bail.

A check of Winthrop's fingerprints revealed that his true name was Norman Henry Hunt, Jr., and that he had been a parole violator in California since 1965. Hunt was charged with three counts of false-pretense theft as felonies, and he entered a guilty plea to the charges. Hunt was sentenced to two years, eight months in prison on the Santa Maria charges. Although the investigation revealed that Hunt had been involved in fraud and false-pretense thefts amounting to a quarter of a million dollars in five different states within the past four years, other local, state and federal agencies declined to prosecute him.

On February 26, 1978, Hunt, who had been serving his term at Chino State Prison, escaped from a minimum security facility.

Hunt is currently being sought by California authorities. Hunt is a white male, 6' 3", 220 pounds, with reddish-brown hair, and hazel eyes. He has worked as a TV repairman and has run businesses marketing CB radios, computer products and jacks for trailers.

His method of operation has been to move to a town under a new identity, rent a house with option to buy and to make contacts in his field of endeavor (recently, computer hobbyists). Hunt will generally begin his operation by soliciting backing for product design from private parties. Often he will sell his qualifications so well that it is the victim's idea to ask Hunt to design a product for him.

Hunt may then start a business and solicit partners. He will rent a building, hire employees, begin a credit line with suppliers. After enough equipment has been received from suppliers on credit to look impressive, he will apply for a bank loan to start production. He will usually go to a local bank rather than a large bank chain. If the loan is received, Hunt empties the business of its equipment and leaves the area, leaving the creditors and the bank high and dry.

Hunt also orders equipment from dealers and pays by check. He then stops payment on the checks. When contacted by a dealer about why he stopped payment, he may say that the product was defective and is being returned, and request that another unit be shipped.

When Hunt was arrested in Santa Maria, he had a loaded shotgun in his closet at home, and he may be considered dangerous.

If anyone has information that may relate to this suspect, please contact Detective Ernest L. Kapphahn, Santa Maria Police Department, (805) 922-7811, or Investigator Zeke Hernandez, Chino State Prison, (714) 597-1821.

The many faces of Norman Henry Hunt, Jr. (AKA Colonel David Winthrop).

SS-50 Bus Manufacturers Meet

All manufacturers of SS-50 bus compatible hardware met at the second Computer Faire in San Jose to discuss possible new bus signal assignments. Represented at the meeting were Southwest Technical Products Corp., Midwest Scientific Instruments, Smoke Signal Broadcasting, Gimix and The Micro Works.

It was agreed the uniformity of use was essential to protect current and future users of the bus from the incompatibility and general chaos now being faced by S-100 bus users and manufacturers. It was agreed by everyone present that any revised, or additional bus line assignments would be cleared with all concerned before being designed into equipment. A suggestion to change the present "Phase 1" line to "Slow Memory" was made by Mr. Childress of Midwest Scientific Instruments. Several others present agreed that this was a reasonable change, since "Phase 1" was a redundant signal that could be obtained by inverting "Phase 2," which is also present on the bus. If no objections are found, this change will be considered for action by all manufacturers of the SS-50 bus to make the change official.

A discussion of possible additions, or changes, to the bus system for MC-6809 processors brought up the subject of monitor and software compatibility in these machines. It was agreed that Mr. Dave Shirk of Technical Systems Consultants, Inc., would be asked to recommend jump table addresses that would be used by all SS-50 manufacturers in these systems. This would insure that all users of this advanced processor on the SS-50 bus would be able to interchange hardware and software easily between monitors written by different sources.

Mr. Robert Lentz, president of The Micro Works, reported that he had conducted some experiments with high speed processors and that he had found no problems with crosstalk, or any need for terminations, etc., at speeds up to 3.0 MHz with a standard SS-50 bus.

The next meeting of the SS-50 Manufacturers Association will be held at Personal Computing 78 in Philadelphia. All manufacturers of SS-50 bus compatible products are invited. All users of the bus are also invited to participate in the meeting and to send any suggestions they may have to any of the above manufacturers for consideration at this meeting.

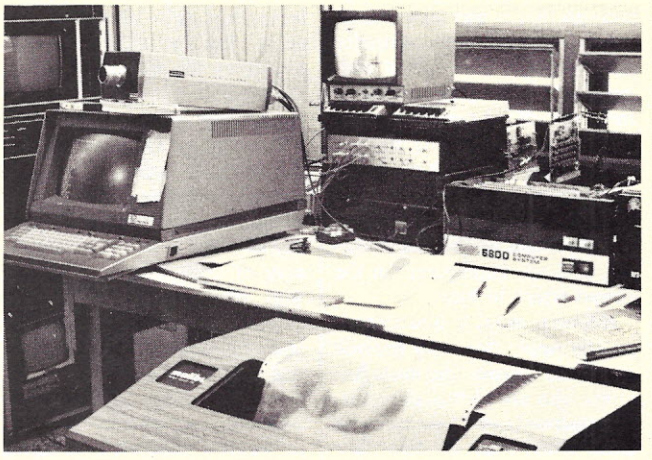


Photo 1. The complete Micro Works/Malibu system.

Intertec's

SuperDEC

"pull out the guts & screw in the brains"

While we'll admit the difference in appearance between the DECwriter II and our new SuperDEC is difficult at best to see, the difference in performance is astounding! The SuperDEC is our new Throughput Optimizer designed to be easily installed in your existing DECwriter II teleprinter. Not only can our SuperDEC Optimizer increase the print speed of your DECwriter II by as much as six times its original speed, it also gives you the features offered only by our famous SuperTerm teleprinter. Features you couldn't get on your DECwriter until now.

You've undoubtedly already heard of our SuperTerm. It's the 1200 baud teleprinter that has been replacing DECwriters by the thousands. And while you may have purchased your DECwriter prior to the introduction of our state-of-the-art SuperTerm, you can now have all of the SuperTerm's incredible features without having to throw out your DECwriter.

With the SuperDEC Optimizer installed, you will have such nifty features as bidirectional printing, manual and automatic top of form, full horizontal and vertical tabs (addressable and absolute), adjustable right and left margins, an RS-232C interface, a double wide character set and up to 32 user programmable characters. You can also add an APL character set, selective addressing and an answer back feature at nominal cost.

The SuperDEC Optimizer is designed to replace the digital electronics in your existing DECwriter II. In less than five minutes, your DECwriter can be transformed into a SuperDEC. The SuperDEC Optimizer is completely "plug-compatible" with the cables in your DECwriter. The only installation tool required is one that we give you—a screwdriver. Just pull out the guts and screw in the brains. No special technical skills are required. And if you get bored watching your DECwriter print faster than you can read, the old digital electronics may be reinstalled in a matter of minutes. It's really just that simple.

Every SuperDEC Throughput Optimizer carries a full one year warranty on all parts and workmanship. But our commitment to excellence in service goes beyond the warranty. Intertec can also offer on-site service contracts for all of your upgraded SuperDEC equipment.

So, when you're ready to "pull out the guts and screw in the brains", contact us at one of the numbers below and we'll give you the name of your local SuperDEC dealer. He'll show you what a difference $395 can make.

$395.00 and your old DECwriter

INTERTEC DATA SYSTEMS

Eastern Regional Marketing
19530 Club House Road
Gaithersburg, Maryland 20760
301/948-2400

Corporate Headquarters
1851 Interstate 85 South
Charlotte, North Carolina 28208
704/377-0300

Western Regional Marketing
17952 Sky Park Blvd.
Irvine, California 92714
714/957-0300

The SuperDEC and other Intertec products are represented in these cities: Albany, NY Alberquerque, NM Atlanta, GA Baltimore, MD Boston, MA Buffalo, NY Charlotte, NC Chicago, IL Cincinnati, OH Cleveland, OH Columbia, SC Columbus, OH Dallas, TX Dayton, OH Denver, CO Detroit, MI Hartford, CT Huntsville, AL Houston, TX Indianapolis, IN Jacksonville, FL Kansas City, KS Los Angeles, CA Louisville, KY Madison, WI Memphis, TN Miami, FL Milwaukee, WI Minneapolis, MN Nashville, TN New Haven, CT New Orleans, LA New York, NY Oklahoma City, OK Omaha, NB Philadelphia, PA Phoenix, AZ Pittsburgh, PA Portland, OR Providence, RI Raleigh, NC Richmond, VA Rochester, NY Sacramento, CA Salt Lake City, UT San Antonio, TX San Diego, CA San Francisco, CA Seattle, WA St. Louis, MO Syracuse, NY Tampa, FL Tulsa, OK Virginia Beach, VA Washington, DC. **International offices** located in Australia, Austria, Canada, Denmark, England, France, Germany, Holland, Switzerland, Taiwan.

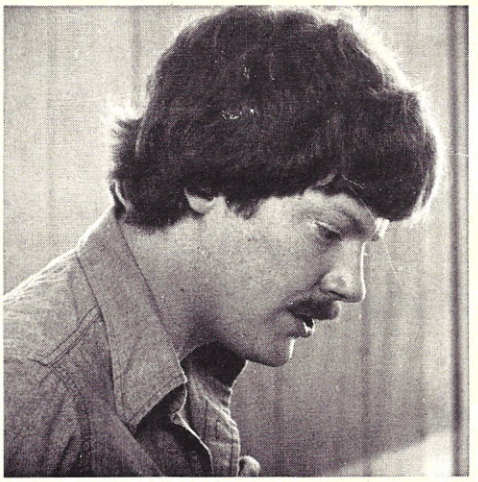


Photo 2. Bob Lentz, president and master thinker.

Fig. 1. Shannon Sherrick, daughter of the Malibu 160's designer, Mike Sherrick.

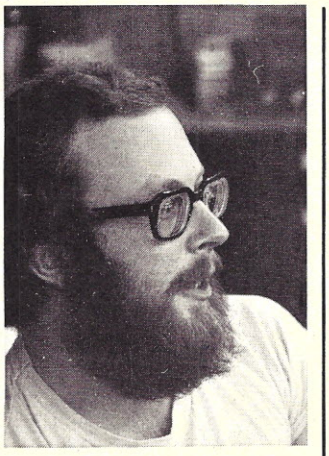


Photo 4. Larry Lowe, layout, draftsman and corporate pilot.

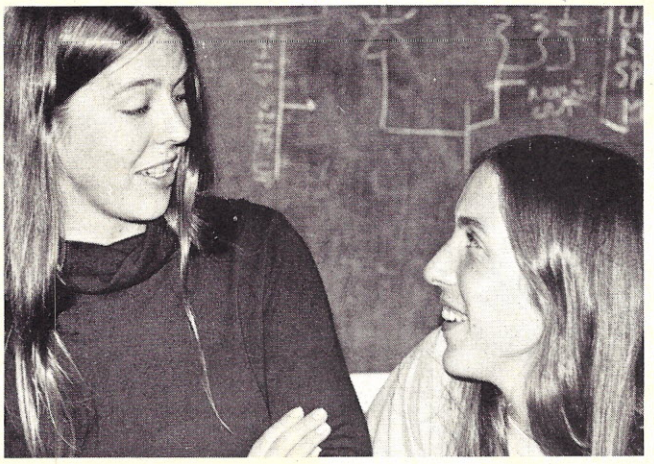


Photo 3. Jill Lentz, marketing, and Ann Curtis, #1 secretary.

Computer Portraits from Micro Works!

Computer portraits have fascinated me for several years, but not for the reason you might think. The electronics, the software and the hardware of the system aren't much of a mystery, or a fascination. No, I've always been amazed at the tremendous cost of such systems and knew it was just a matter of time before some enterprising micro enthusiasts came along and developed one we could all buy. Well, it's happened. Let me tell you about it. . . .

In last month's editorial I gave you an introduction to what the folks at The Micro Works are up to. They've been building S-50 6800 boards for some time now (they have an EPROM Programmer, PROM board, Universal I/O board and extender boards), but their latest is really something!

They have developed a digital video system, called the Digisector[R], which interfaces an inexpensive TV camera with a Southwest Technical Products 6800 system. The TV image is converted, by the Digisector board, into a high-resolution digitized picture . . . and stored into the computer's main memory. So far, so good . . . and, up to now things have been *quite* inexpensive: the cost of an SWTP 6800 system, a $200 to $300 television camera, a video monitor for $150, $170 for the Digisector board and a terminal for the computer. Not too bad, right? Now we're going to have to spend a few bucks for a good high-quality printer . . . and the Micro Workers feel the Malibu 160 is the best for the job . . . and from what I've seen, I'll have to agree (catch the review on that printer in this month's *Kilobaud*).

Now, let's do a recap of the hardware, while referring to Photo 1. Going clockwise, starting on the left-hand side of the table, we have the TV camera sitting on top of the terminal (incidentally, you're going to need some floodlights aimed at the subject), then we have a monitor for the video, the SWTP system with the Digisector sitting on an extender board (the right one), minimum of 18K of main memory and last, but not least, the Malibu printer. Add it up . . . it's a heck of a lot less than anything you've seen before! (The cost of the Digisector board includes the computer portrait software.)

Photos 2 through 6 will introduce you to the sharp team at Micro Works who put it all together . . . and Fig. 1 speaks for itself; The Micro Works/Malibu combination is a real winner! (By the way, they have an 8080/S-100 version of the board in the works, which will sell for about the same price.)

Micro Works, PO Box 1110, Del Mar CA 92014. Ph: (714) 756-2687.

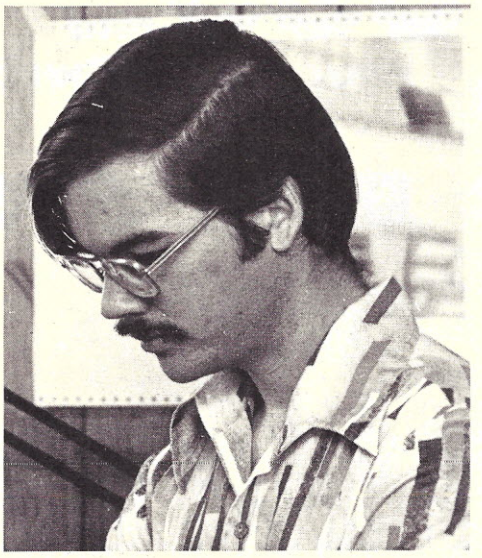


Photo 5. Andrew Phelps, senior programmer.

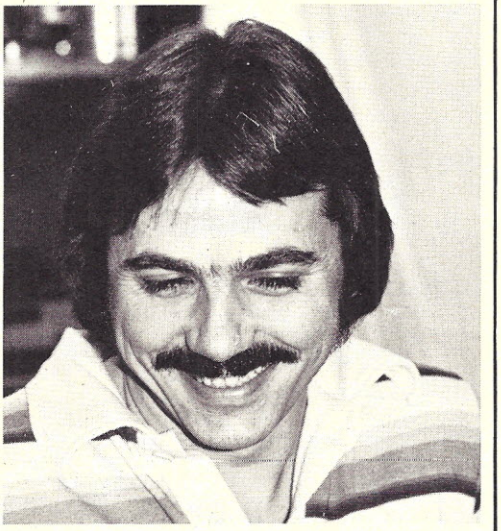


Photo 6. Bob McMann, tech writer and senior technician.

BOOKS

8080A/8085 Assembly Language Programming
Lance A. Leventhal
Adam Osborne & Associates, Inc.
PO Box 2036, Berkeley CA 94702
$7.50, 400 Pages

Assuming that there are other computer hobbyists who enjoy assembly-language programming as much as I do, I would like to pass on my thoughts about *8080A/8085 Assembly Language Programming* by Lance A. Leventhal.

I use assembly language in situations where BASIC won't do the job, such as graphics, input-output, or where BASIC programs won't fit due to memory size limitations. In addition to the usual I/O operations (keyboard, printer and video), I turn various external devices on and off under computer control. This requires being able to manipulate CPU registers, addresses and data lines; it takes assembly-language programming to do this.

I have written many programs, but after skim-reading this book I realized that I have missed the significance of, or misused, many 8080 instructions. A second, more thorough, study confirmed this and contributed greatly to my assembly-language programming ability.

Table 1 is an outline of the contents of Leventhal's book. Just about every possible question that you could come up with is answered in one or more of these chapters. Chapters 1 and 2 serve as the appetizer—a comprehensive discussion of assembly-language programming and assemblers.

Chapter 3 does more than just list the instructions with a brief description; a half page or more is devoted to each instruction and explicit examples promote better understanding. Nowhere else have I seen the 8080 instruction set explained with such detail and clarity.

Chapters 4 to 12 are the main course; they take you from the simple program through every conceivable CPU operation. I found the code-conversion and I/O information especially interesting since my current project is to interface an EBCD Selectric Data Terminal to my SOL.

There is hardly a page in this book that does not contain at least one example program with source and object coding plus flowchart. These examples are really subroutines that you can use in countless programming situations.

A partial list of these subroutines might include: checksums, finding a given ASCII character, changing the parity of a string of characters, ASCII-to-decimal conversion, addition, subtraction, multiplication, division, sorting, indexing a table, code conversion and so much more. In fact, the emphasis in chapters 5 to 12 is on subroutines that can be combined to form more complex programs.

Chapters 13 to 16 tie together everything you have learned. This is the dessert course. My assembly-language programming technique always started with coding after some sketchy mental problem definition. Dr. Leventhal has convinced me that this is wrong. Problem definition and program design should come first, followed by coding, debugging, testing, documentation, maintenance and redesign.

1. Introduction to assembly-language programming
2. Assemblers
3. 8080/8085 instruction sets
4. Simple programs
5. Simple program loops
6. Character-coded data
7. Code conversion
8. Arithmetic problems
9. Tables and lists
10. Subroutines
11. Input-output
12. Interrupts
13. Problem definition and program design
14. Debugging and testing
15. Documentation and redesign
16. Sample projects

Table 1.

8080A/8085 Assembly Language Programming has many more points to make . . . too many to cover here. This is not a one-evening book. If you have an 8080 or 8085 (improved 8080) CPU or have access to one, the ideal learning situation is to try the examples as you go along. Each chapter has, in addition, a series of problems for which clues, but no coded solutions, are supplied. These give you a chance to try your hand at assembly-language programming.

Particularly interesting is the discussion on various programming methods: flowcharting, modular, structured and top down. Although no one method is touted as being *the best*, each is explained, and advantages and disadvantages presented. Clearly, the author leans toward structured programming.

Major statements are printed in boldface type, and explanations to these statements are printed in a lighter type. The tendency is to read only the boldface sentences until you come to one that you don't understand, at which time you read the lightface type for clarification. Out of habit, I found myself reading it all.

This is definitely a software-oriented text, but an amazing amount of hardware information is given in the I/O and interrupt chapters—probably enough to implement any of the designs discussed.

So far, I have covered all the book's good points but none of its bad ones. That is probably because I couldn't find anything to criticize. My only negative reaction has to do with *8080A/8085 Assembly Language Programming* having been advertised as available in October 1977, which is when I ordered and paid for it; it was actually not printed until late January 1978, which is when I received it.

In my opinion, *8080A/8085 Assembly Language Programming* is a worthwhile text; and I'm hoping for a Z-80 version soon. If my technical library had to be reduced in size for some reason, this is certainly one book I would keep on the shelf!

Rod Hallen
Tombstone AZ

Simplified BASIC Programming
Gerald and Joan Silver
McGraw-Hill, New York
1974, $12.85

Simplified BASIC Programming is an excellent text for those of you who have absolutely no experience in computer programming and occasionally need to look up the definition or application of an instruction. *Simplified BASIC Programming* is an excellent reference manual.

The first section of the book is devoted to an in-depth explanation of the operation of a time-sharing system. For those of you who have access to a time-sharing system, this section is invaluable. For the microcomputer owner, this section may be skipped as your system probably operates in a substantially different manner.

The second section describes, in easy-to-understand language, how most of the instructions are used. I say *most* because in 1974 BASIC was not as sophisticated as it is today. Examples of the use of each instruction or combinations of instructions are clearly stated. At the end of each chapter, a review and a quiz are provided.

The last section of the book contains example programs with complete documentation and a description of the way the problem was solved.

This book is a good reference for those of us who can't seem to remember whether a comma or a semicolon is necessary to print closely spaced output, or any other syntax problem that may drive you to the brink of insanity.

Although *Simplified BASIC Programming* is available through any bookstore, you may find a used copy for sale at substantial savings at your friendly, neighborhood college bookstore. And if you are really watching your budget, you may find *Simplified BASIC Programming*, along with other informative reading on BASIC, at your local library.

Jim Cambron
Topeka KS

The 8080A Bugbook
Rony, Larsen, Titus
Howard W. Sams & Co., Inc.
Indianapolis IN
$9.95, paperback

One book out of a hundred makes you wish you had seen that one before slogging through the other ninety-nine. This is such a book. It should be subtitled "All You Wanted To Know about the 8080 and Its Support Chips, but Didn't Know Where To Look."

In the Bugbook tradition, the 8080A neatly balances theory and practical example. It comprises eight chapters with titles such as,

"What is a Microcomputer?" and "An Introduction to Microcomputer Programming." They are all informative and readable.

Unfortunately, there are some errors (no doubt accidental, but possibly confusing to the reader). Occasionally, the authors give a detailed explanation that ends just when you expect some vital truth to be revealed; but these rare omissions serve mainly to demonstrate the thoroughness of the rest of the book.

Each chapter begins with an outline and ends with a summary and some searching questions. In light of its format, it could well be used as a textbook. Let's take chapter 4 to consider the book's style.

Title: Generating an output pulse.
Outline: Objectives, definitions, 8080 I/O instructions, device select, pulse decoding, sample microcomputer program, device select pulses as control pulses, example, test, and "What have you accomplished in this chapter?"
Introduction: "In this chapter you will learn how to generate device select pulses . . . "
At the end of the chapter the reader is asked to "draw a schematic diagram for a circuit that can generate up to 256 different device-select pulses."

And if you read the chapter you should be able to do the above, and a great deal more.

In following chapters the authors explain the use of these and other signals for the control of outside devices via timing loops and other programming sequences. Throughout, however, they stress keeping the hardware simple and exercising control by software.

I appreciated most of the simplified, no-mystique approach to several things that had long bothered me—among these were flag testing, the use of status words, and the inside working of the many conditional branch instructions. The entire instruction set is covered in greater detail than I had previously encountered. It is methodically considered by function—by grouping the related logical operations, for example—and whole pages are devoted to illustrating certain instructions that might be considered tricky or difficult.

The use of octal may disappoint some readers. The explanation is that the 8080 instruction set was designed this way. Logical operations all begin with 2 in octal, and MOV instructions with 1. The accumulator is 7 and the memory 6. Thus, MOV A,M and MOV M,A are 176 and 167, respectively, much easier to remember than two dissimilar hex codes.

The book's overall theme is that the microprocessor is a useful tool. No mention is made of high-level languages, games or heavy number crunching; the interfacing is to practical devices and the programs are in simple machine language, all designed to "do something." And although the special 8080 support chips are all covered in some detail, TTL alternatives are explained where they can be applied.

It is difficult to classify this as either a hardware or a machine-language software book, since it is really both. If the reader could previously build a kit or follow a program, he should, after digesting this volume, be able to design much of his own hardware and write programs to interface with other devices. That's a lot to learn for only ten bucks.

Ernie Brooner
Lakeside MT

The Home Computer Revolution
Theodor H. Nelson
The Distributors,
702 So. Michigan South Bend
IN 46618, $2

Most computer hobbyists, or those about to get into computing, will find this book easy to read, as well as entertaining. It is neither a technical book, nor a dry history book. The author has combined semitechnical material, computer-historical anecdotes and his forecast of the role of the computer in the future.

Reading this book, I found that my level of interest wavered between near boredom to moderate interest. However, because of the nature of the material, another reader might find different peaks and dips of interest.

For instance, as an advocate of the Altair bus, I reacted favorably to the author's repeated support of this configuration. A reader using the Digital Group bus, for example, might be disinterested in the Altair bus coverage.

At the other end of my interest spectrum, I found the frequent attacks on IBM to be objectionable. I have no particular like or dislike for IBM, but I certainly found the repeated negative attitude distracting.

It's a matter of psychology—if you like the Altair bus and have something against IBM, you'll enjoy the author's comments; on the other hand, if you don't like the Altair bus structure and have a high regard for IBM, you won't enjoy reading this book.

A little more than half of *The Home Computer Revolution* is related to the author's predictions of the future home-computer world. Therefore, if you are going to read this book, do it now; very shortly, these precarious prognostications will either be history or wrong guesses. Some of the predictions concerning future home-computer input/output devices and techniques seem way out (but so was *1984* not very long ago).

On the positive side, I thought the historical notes on Mits, Cromemco and other companies were very interesting. Those readers new to home computing will find some seldom published background information.

There are brief hardware descriptions (Altair bus oriented), but with home computing moving so fast, a book would have to be published in loose-leaf style to keep up with the hardware changes. Only a monthly magazine, such as *Kilobaud*, can hope to keep you informed on the current hardware.

The program-languages descriptions are short, with most languages getting only one paragraph. The author suggests that a person learn programming with a BASIC interpreter, and this is probably what most home computerists are doing.

A serious oversight occurs on page 117. Add the following to the lists of available magazines on that page: *Kilobaud*, Peterborough NH 03458.

The *Home Computer Revolution* is light reading and generally entertaining; one of my next reading projects will be *Computer Lib* ($7, same source), which is referred to often in this latest book by Theodor Nelson.

Gordon Flemming
Sylmar CA

Home Computers: 2^{10} Questions and Answers;
Vol. 1: Hardware ($7.95)
Vol. 2: Software ($6.95)
Rich Didday dilithium Press
Forest Grove OR 1977

These two books fill a definite need. Most people who get started in the home-computer field find themselves in one of three situations: They know quite a bit about software but nothing about hardware; they know quite a bit about hardware but nothing about software; they don't know much about either one.

The idea behind these books is that you can buy Vol. 1 if you're in the first category, Vol. 2 if you're in the second category, or both if you're in the third category.

That's the idea behind the books, but how well do they pull it off? Pretty darn well, I'd say.

Together, the two books represent a heavily edited transcript of nine days of conversation between two people on the subject of home or hobby computing. One of the participants (called "A" because he provides the answers) has a strong background in computing in general (both hardware and software), and home computing in particular.

The other participant (called "Q") is an intelligent, interested newcomer to the field who has visited the computer stores, picked up some literature and bought a few magazines, but needs further help to figure out what it all means. He doesn't understand too much of what he's read, and wants to know, for example, what is really involved in putting a computer kit together.

Is he better off getting a fully assembled system? Why are there so many different microprocessor chips? What does all this RAM/ROM/PROM/EPROM stuff mean? What's involved in programming? Why are there so many different programming languages? What can you *really* do with a home computer?

1024 is 2^{10}, which is the number of questions and answers in the two books—thus the title for the work. But it's more than just a bunch of disjointed questions thrown together. The books are well organized and proceed logically from one topic to the next, building up your knowledge and tying things together as you read.

Of course, neither book is going to enable you to become a professional programmer or hardware designer overnight, but they'll give you a better idea of what these people do, and introduce you to some of the basics as they relate to home computing.

Usually, when I read an introductory level book or article on computing, I find myself saying, "That's not a very good example," or "Boy, that's sure going to mislead somebody." These books are a rare exception. The questions and answers both have a nice balance of simplicity, accuracy, and (amazingly enough) realism, and actually convey the

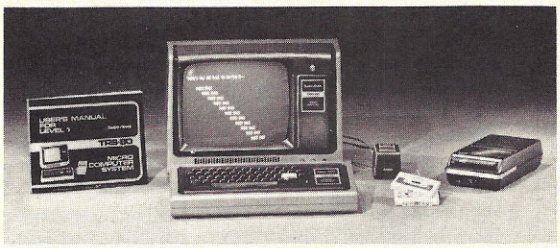
(continued on page 111)

Radio Shack's personal computer system? This ad just might make you a believer.

You can't beat the 4K system at $599

TRS-80 "Breakthru"
- TRS-80 microcomputer
- 12" video display
- Professional keyboard
- Power supply
- Cassette tape recorder
- 4K RAM, Level-I BASIC
- 232-page manual
- 2 game cassettes

...or the step-up 16K system at $899



TRS-80 "Sweet 16"
- Above, except includes 16K RAM

...or the fast 4K/printer system at $1198

TRS-80 "Educator"
- Above, except includes 4K RAM and screen printer

...or the Level-II 16K/printer/disk system at $2385

TRS-80 "Professional"
- Above, except includes 16K RAM, disk drive, expansion interface, and Level-II BASIC

So how are you gonna beat the system that does this much for this little? No way!

...The amazing new 32K/Level-II/2-disk/ line printer system at $3874

TRS-80 "Business"
- Above, except includes 32K RAM, line printer, and two disk drives

Get details and order now at Radio Shack stores and dealers in the USA, Canada, UK, Australia, Belgium, Holland, France, Japan.
Write Radio Shack, Division of Tandy Corporation, Dept. C-051/B, 1400 One Tandy Center, Fort Worth, Texas 76102. Ask for Catalog TRS-80.

Radio Shack®
The biggest name in little computers

NEW PRODUCTS

Plotters—Kit and Assembled

Sylvanhills Laboratory, Inc., has been sold to Pitsco, Inc., and offers plotter kits and plotters completely assembled. The kits require the purchaser to mount them on a drawing surface (console also available as a new product of Sylvanhills) and to do the interconnection between the control PC boards and his computer. Plotters require an 8 bit parallel I/O port and 5 and 24 V power sources. A basic 8080 software program is included in the owner's manual.

Sizes available are 11 x 17 ($795 in kit form), 17 x 22 ($950 in kit form) and 22 x 34 ($1300 in kit form). Consoles priced separately.

Contact the new offices and manufacturing facilities of Sylvanhills Laboratory, Inc., PO Box 646, Pittsburg KS 66762.

202 Video Camera Kit

Solid State Sales 202 Video Camera Kit may be used for visible or infrared viewing for character recognition with computers with external circuits. It will operate in a vacuum, under water, at high altitude or in a magnetic environment because there is no high voltage or magnetic deflection. In addition, it may be used for IR surveillance with an IR light source, and is excellent for standard surveillance work because of its light weight (under 1 lb.) and small size.

Some advantages offered in this new kit from previous models are all clock voltages operating at 6 V requiring no adjustments, and a higher video output signal. The circuitry has been simplified for easier assembly, and a two-level TTL output is supplied for interfacing. In addition, a power board is supplied so only a 5 V, 1 Amp power source is needed, and, in the near future, Solid State Sales will supply a computer interface card.

This kit includes all semiconductors, boards, data sheets, diagrams, resistors, capacitors, and an 8 mm lens. Assembly has been simplified so that the only equipment needed is an oscilloscope, soldering iron and some wire. The complete kit sells for $349 ($75 to assemble and test).

Solid State Sales, PO Box 74K, Somerville MA 02143.

Serial Interface Module

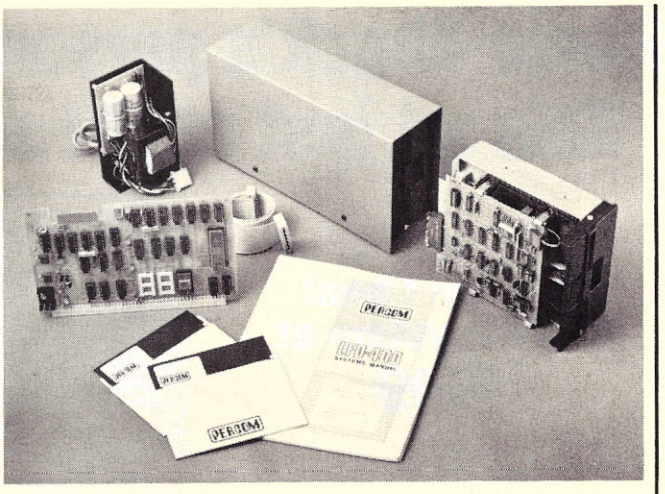
The 9650 is an asynchronous serial interface module specifically designed for compatibility with the M6800 microprocessor bus. It is pin and outline compatible with the Motorola EXORciser and Micromodules and with the MEK6800D2 Evaluation Kit. It features full address decoding and fully buffered data, address and control lines. This module utilizes 8 MC6850 Asynchronous Communications Interface Adapters with full RS-232C signal conditioning. An on-board bit rate generator simultaneously provides 14 standard rates that can be individually strapped to each ACIA.

The 9650 occupies 16 consecutive memory addresses. The lowest 8 of these access the 8 control/status registers and the next 8 access the transmit/receive data registers. This map arrangement allows optimum use of indexed addressing in I/O intensive systems and permits the use of a very tight interrupt polling loop.

The standard configuration of the 9650 is fully populated to 8 channels. Prices range from $395 in single quantities to $237 at 100. A partially populated 4-channel version is also available at lower prices.

The 9650 is one of a family of M6800 support modules. All cards of the family are 6.05 inches by 9.75 inches and utilize a 43-pin dual readout edge connector with 0.15625 inch pin spacing.

Creative Micro Systems, 6773 Westminster Avenue, Westminster CA 92683.



PerCom's LFD-400 system.

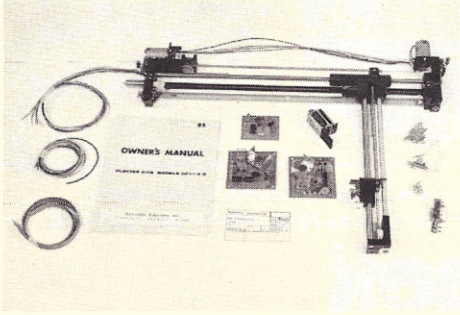
Disk Storage System for the SS-50 Bus

PerCom Data Co.'s LFD-400, a minifloppy[R] disk memory system for the SS-50 bus, includes a controller PC board, PROMware disk operating system, disk drive and drive power supply, interconnecting cable, two minidiskettes, an operator's manual and a compact enclosure to house the drive and drive power supply. System components may be individually purchased, and 2- and 3-drive systems are also available.

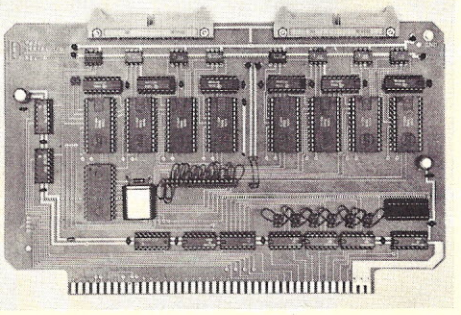
The controller board, which is installed in an SS-50 bus slot of the host computer, includes special low-voltage-drop regulators, a proprietary "bit shifting" compensation circuit, an inactivity time-out circuit to increase drive motor life, and provision for 3K bytes of PROM. The LFD-400 PROMware DOS, miniDOS, allows SS-50 bus owners to use their existing software with simple patches. This was a priority consideration in the development of miniDOS.

The LFD-400 uses the Shugart SA-400 drive. Disk speed is 300 rpm, which gives a data-transfer rate of 125 kilobits per second. The read/write head is stepped from track to track at 40 ms per step. The SA-400 drive system features a positive media interlock, which prevents door closure on a misaligned disk, and write protection circuitry. The LFD-400 storage media is a 10-sector hard-sectored minidiskette, which accommodates 89.6K bytes of data on 35 tracks. The recording technique is Bi-Phase-M (also known as "double frequency").

PerCom Data Company, Inc., 318 Barnes, Garland TX 75042.



Some of Sylvanhill's wares.

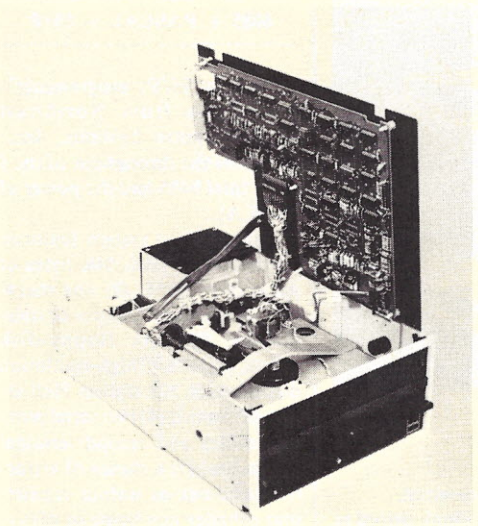


The CMS 9650.

CT Terminals

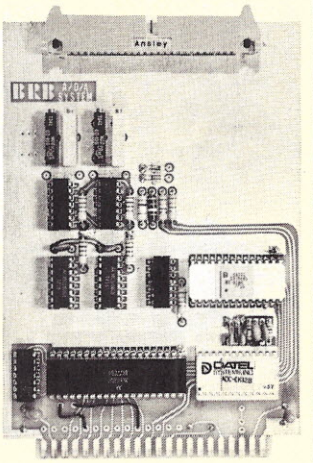
COMPUTER TEXTile announces its line of high-quality hard-copy hardware. CT sells reconditioned QUME and Diablo daisy wheel printing terminals, which feature 30-cps printers, 96-character keyboards with 10-key numeric pad, ASCII coded, RS-232 interface.

Also included are 256-charac-



The Innotronics Series 400 floppy disk drive.

CSD's Microdesk.



Wintek's analog interface module.

ter buffer, user's and service manual, with full graphics capability packaged in a cabinet with black-and-chrome-wheeled pedestal. Options include 45-cps and 55-cps mechanisms for some QUMEs, other encodings, pin-feed platen, tractor forms feeder and service contracts.

Each terminal comes with a limited 30-day warranty. Quantities are limited. Prices from under $2000. Also available are reconditioned ADM-1s, modems and paper tape punch/readers.

COMPUTER TEXTile, 10960 Wilshire Blvd., Suite 1504, Los Angeles CA 90024.

Innotronics Floppy Disk Drives

The new Series 400 diskette drive, offering an array of new features that were previously unavailable in the market, has recently been introduced by Innotronics. Unique new features include automatic head-unload and stepper motor time-outs, bidirectional write-protect, radial stepping ability for truly overlapping seeks, host power-failure detector and six different LED activity indicator electronics.

Both the Model 410 (soft-sectored, IBM-compatible) and the Model 420 (hard-sectored) provide single- and double-density recording capability. In addition, a proprietary data separator design, coupled with a digital noise filter and a unique way of handling recorded signals, results in 35 percent greater data integrity margins.

The Series 400 also incorporates the field-tested Innovex mechanical design, which includes filtered air operating environment, single-side accessibility for maintenance, mechanical door interlock with a manual override button, targeted media loading, and a patented "wear-free" diskette hub rated for over 100,000 insertions. Prices for the Innovex Series 400 range from $575 in single quantities to $435 each for orders of 100.

Innotronics Corporation, Brooks Rd., Lincoln MA 01773.

Printer Interface for Apple II

Microproducts has announced a printer interface for the Apple II computer which is compatible with the Southwest Technical Products PR-40 Printer. It will be marketed as a preassembled PC board that plugs directly into the Apple II computer, an interconnecting cable and a cassette containing the operating software.

The printer prints one line at a time when the return key is struck. The printer subroutine can also be called in BASIC to print the entire contents of the video screen. While in the BASIC mode, using the list subroutine, the printer will continually record the program, while the video screen scrolls up one line at a time. The complete plug-in interface with software sells for $49.95.

Microproducts, Dept. K, 1024 17th Street, Hermosa Beach CA 90265.

Microcomputer Storage System

The Computer Systems Design Microdesk is a new addition to *Kilobaud*'s microcomputer lab. (We ran a release on the Microdesk in November 1977; now we've had a chance to utilize it.) The desk's ease of assembly makes for a quick and useful addition to any room, with one adjustable shelf that you can arrange to your specific needs. Because of its air-vented design, the upper shelf is an excellent location for your unit. You can keep the unit close at hand without its being in the way. There's plenty of room for your terminal, and a sliding keyboard shelf can put the keyboard within comfortable reach—or out of the way when you're not using it.

The lower shelf fully handles the task of holding all the manuals that accompany a small microcomputer lab. The Microdesk is sturdily designed to last a long time under normal conditions.

Computer Systems Design, 1611 E. Central, Wichita KS 67214.

Microprocessor Analog Interface Module

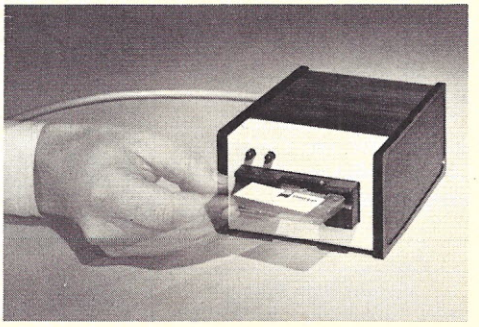
The Wince Analog Interface Module makes it easy for laboratory and control engineers to interface thermocouples and other transducers to a microprocessor. It makes it equally easy to interface the microprocessor to motors, servos, etc. Options include a 16 channel multiplexer, an 8, 10, or 12 bit analog-to-digital converter, and one or two 8 bit digital-to-analog converters. The base price is $99. Other Wince Modules include the Control, RAM, ROM, EROM Programmer, CMOS RAM/Battery, Driver/Sensor, Console I/O, Cassette Interface.

Wintek Corp., 902 N. 9th St. Lafayette IN 47904.

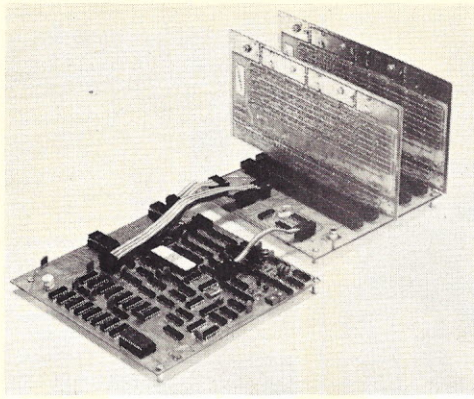
The Stringy Floppy

The Exatron Stringy Floppy™ is a subsystem consisting of a con-

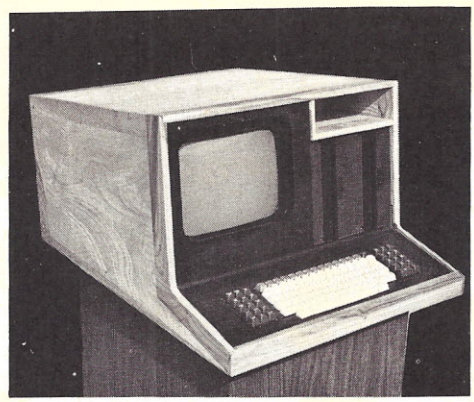
Microproducts interface with Apple and PR-40.



Exatron's Stringy Floppy.



Central Data 2650 Computer System.



Northwest's 85/P.

trol board connecting to the S-100 bus, a small drive module outside the computer mainframe and the connecting cable.

The individual continuous-loop tape wafer, less than a fourth the bulk of the standard audio cassette and holding up to 40K bytes, is inserted in the slot in the front of the drive module, and will save or load 4K bytes in about 5 seconds. All operations are software controlled; the utility programs are contained in an EPROM on the control board. The subsystem is delivered ready to operate, and is backed by a one-year full warranty and a 30-day money-back guarantee.

Exatron Corp., 1030 East Duane, Suite I, Sunnyvale CA 94086.

The Electric Pencil II

Michael Shrayer Software, 3901 Los Feliz Blvd., Los Angeles CA 90027, announces the Electric Pencil II. Some of the new features include: CP/M compatibility, simple file management, dynamic print formatting, multi-column printing, cassette backup capability, centering, underlining and boldface.

The Electric Pencil II is now available on CP/M—standard printer versions $225; Diablo printer versions $275. System hardware must include: 8080 or Z-80 based microcomputer, printer, video display, CP/M supported disk system, or North Star minifloppy disk, or cassette interface (Tarbell or SOL).

The Electric Pencil I is still available for non-CP/M users. Contact Michael Shrayer for more information.

Central Data Boards

Central Data, PO Box 2484, Sta. A, Champaign IL 61820, offers a 16K RAM board specially designed for use in S-100 computers. The dynamic memory board uses a reliable refresh method that inserts cycles between the computer's normal access cycles. The 16K RAM board uses less than one-half the power of a comparable static RAM board.

CD's board comes completely assembled, tested and burned in—just plug it in and start using. Each board also comes with a full one-year warranty. Price is $289. There is capacity on the board for up to 32K RAM ($475), or add 16K for $200.

S-100 extender board, assembled and tested, is $110. The 2650 Computer System board retails for $275. System board features include: 80 x 16 line display, 2650 microprocessor, 300 baud cassette interface, supervisor program, two parallel ports, one input and one output, and 2048 bytes of read-write memory.

Naked Terminal Cuts Dumb Terminal Costs ⅓

Dynabyte, Inc., lowers the cost of a dumb terminal with its Naked Terminal, an S-100 module that functions with a keyboard and video monitor.

The Naked Terminal, priced at $395, displays 80 characters by 24 lines, using both uppercase and lowercase characters in a 5 x 7 font. Half duplex, full duplex and a block mode that allows editing before transmission are features of the Naked Terminal. Editing is aided by an addressable cursor.

Switch-selectable features include black-on-white or white-on-black, blinking or nonblinking __ cursor, and variable baud rates.

No software is required. The Naked Terminal can be configured by DIP switch to drop into an existing system, replacing the serial I/O card and stand-alone terminal without making any changes to software.

The Naked Terminal is a complete dumb terminal on an S-100 board. It contains a microprocessor with its own memory, its own software drivers and its own internal bus. It won't take up any of the 64K memory address space of the S-100 bus.

Like all Dynabyte products, the Naked Terminal is completely assembled, socketed, tested and burned in. Dynabyte's guarantee is for a full year—the longest in the industry.

Dynabyte, Inc., 4020 Fabian, Palo Alto CA 94303.

8085 + PASCAL = 85/P

The new 85/P, programmer's workbench from Northwest Microcomputer Systems, Inc., combines the throughput of the 3 MHz Intel 8085 and the power of PASCAL.

The standard system features: (1) 8085 CPU with 54K bytes of static user RAM; (2) one megabyte of storage in two double-density Shugart floppy-disk drives; (3) 24 x 80 high-resolution display with 103 station Hall effect keyboard; (4) two serial ports for printer and second terminal or modem; (5) a choice of attractive solid oak or walnut cabinets that enhance any home or office.

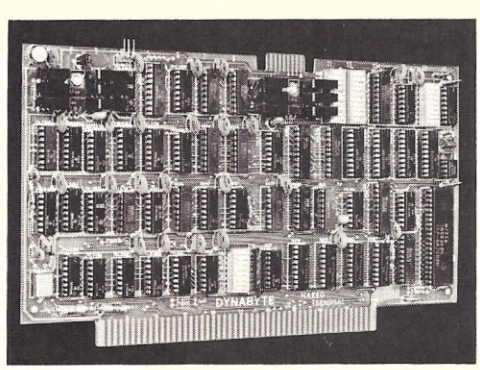
The 85/P gains its efficiency in program preparation and code execution from the increasingly popular PASCAL language. The 85/P provides the full PASCAL environment including a 700 lpm compiler/interpreter, random and sequential files, a screen-oriented editor, interactive, source-linked debugger, plus full documentation and a 90-day warranty.

The complete system costs $7495. Delivery is quoted at 30 to 60 days, with Northwest Microcomputer Systems paying for delivery on any order shipped later than 60 days. A variety of options is available.

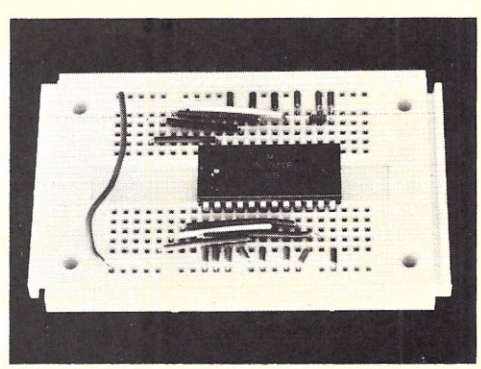
Northwest Microcomputer Systems, Inc., 121 E 11th, Eugene OR 97401.

"Byte-Size Breadboards" from CSC

The age of LSI has put a lot of power in Lilliput for users of Continental Specialties Corporation Experimentor Socket solderless breadboards. This seems especially true for the palm-size EXP350 and EXP650. Each is just 3.6 inches long. The EXP350 offers .3 inch center spacing to



Dynabyte's Naked Terminal.



The EXP650.

accept standard DIP packages; the EXP650 offers the wide .6 inch spacing appropriate to wide LSI DIPs. Their small size offers the perfect opportunity for byte-size modularity. This can happen in several ways.

A complex LSI function IC like a UART, for example, can be accommodated, along with pertinent support discretes and connecting cables as a module on a CSC EXP650. An LSI function can be synthesized with less complex circuitry. A counter, decoder and display, for example, can be combined on a single EXP350 and treated as a unit—as can a data converter, an interface circuit or any of a number of functional modules.

CSC's EXP350 is priced at $5.50 (unit), the EXP650 at $6.25.

Continental Specialties Corporation, 70 Fulton Terrace, New Haven CT 06509.

REX Computing System

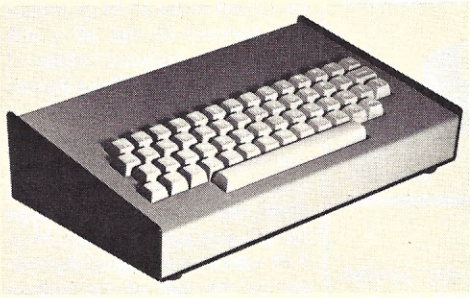
RCC introduces REX—the total microcomputer system, fully assembled, complete with a Z-80 CPU, 24K of RAM, video output, system keyboard, a microfloppy disk drive featuring double-sided recording, cabinet and power supply.

The REX system includes an S-100 motherboard containing the CPU, video display interface, bootstrap and Monitor PROM, and powerfail and vectored interrupt circuitry. The system comes complete with a modern walnut-sided cabinet and a 15 Amp power supply, and includes space for a second microfloppy drive plus five slots for S-100 bus options.

A complete line of low-cost software options is available. These include ANSI FORTRAN IV with subroutine library and 8080 and Z-80 extensions, including advanced math and string-handling functions; floppy-disk operating system; file management system; text editor; and linking loader.

RCC offers a wide range of options for the REX system, including b & w or color video monitors, rf modulator generator, expansion microfloppy drives, RAM memory to 64K on the motherboard (no bus slots needed), a 120 cps 80/96 column printer programmable serial communications channel, and a data communications modem. The REX system lists for $2495, assembled and tested only.

Realistic Controls Corp., 404 W. 35th Street, Davenport IA 52806.



GRI Model 756 keyboard.

New Model 756 Full ASCII Keyboard

The Model 756 keyboard from George Risk Industries provides encoding for all 128 ASCII characters and control functions, imposing no limitations on software design or hardware capability. Utilizing reliable IBM series keyswitches and low-power MOS encoder circuitry, Model 756 is designed to bridge the gap between basic keyboards and expensive custom OEM models. Assembly and mounting are simplified through OEM industrial grade components and a rugged MIL-grade printed-circuit board. The durable circuitry is complemented by custom molded keytops and a line of heavy-gauge steel enclosures for desktop use.

The 756's complete line of accessories includes a numeric pad, custom cables and connectors. The versatile interface allows user selection of parity, positive or negative logic data and strobe outputs, alpha lock operation and both dc level and pulse strobe signals. A latching shift lock key is included, and all outputs are TTL-DTL-MOS compatible. Kit is $64.95; assembled and tested model, $75.95. A matching enclosure, Model 702, is $29.95.

George Risk Industries, Inc., GRI Plaza, Kimball NE 69145.

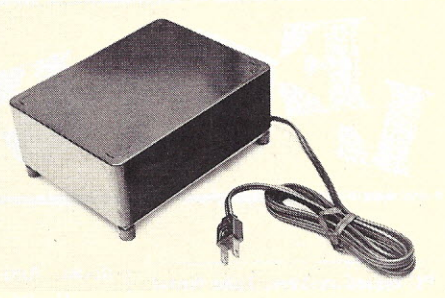
Computer-related Cases

The Buckeye Stamping Company, 555 Marion Rd., Columbus OH 43207, now offers instrument cases with keyboard holders and CRT canopies. These computer-related additions, fabricated of durable, extruded aluminum, are offered in standard 17 inch widths. The new cases are now offered with blue or black vinyl tops with matching feature stripes, or with teakwood vinyl as an option.

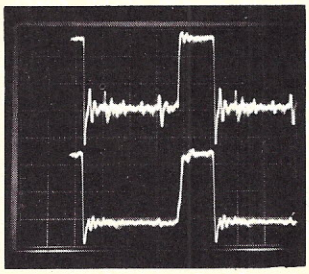
The new Buckeye computer-related cases sell in small quantities in a price range of $110 or $215, complete.

Power Supply for KIM

K L Power Supplies, PO Box 86, Montgomeryville PA 18936, announces the model 512 power supply for MOS Technology KIM users, and for others needing a 5 volt and 12 volt regulated supply. The model 512 comes completely assembled and includes a total 4.3 Amp capacity and additional 8K memory.



K L Model 512 Power Supply.



Bottom oscilloscope signals show noise reduction made possible by the Glitch Grabber.

The K L power supply features +5 volts regulated with 1.4 Amp maximum, +12 volts regulated with 1.0 Amp maximum, +8 volts unregulated with 4.5 Amp maximum, and +16 volts unregulated with 1.0 Amp maximum. It has regulated outputs with current limit and thermal overload protection, fuse-protected primary, ac line cord, and connector cable.

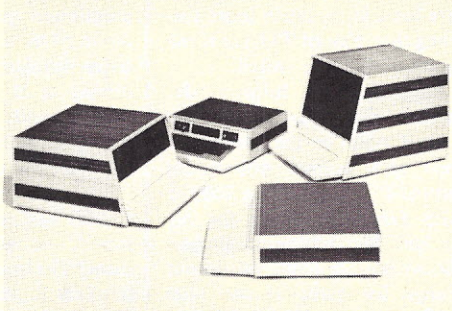
The unit is enclosed in a Bakelite case with aluminum bottom plate and rubber feet. It is 6.8 x 5.6 x 3 inches and weighs 3.5 lbs. Price is $37.

New "Glitch Grabber" from Extensys

A board interconnection device from Extensys Corp. significantly reduces noise, glitches and jitter on the S-100 microcomputer bus and carries a suggested retail price of $79.50 in single quantities (large-volume discounts available). Called the "Glitch Grabber," the printed circuit edge-connective device maintains clean signals on the notoriously noisy S-100 bus, safeguarding the low tolerance volt-

(continued on page 111)

RCC's REX Microcomputer.



Buckeye instrument cases.

LETTERS

PC Board-makers, Take Note!

Your otherwise fine article on making printed circuit boards (*Kilobaud*, April 1978) fails to give instructions and precautions for handling the chemical used to develop the photoresist-coated boards. The resist developer recommended is of completely different nature than the chemicals normally encountered by the home photography enthusiast.

I'm sure that your readers are aware that the resist developer is flammable and will take precautions to exclude potential ignition sources. They may not be aware that methylene chloride is the active ingredient in paint remover. As such it will rapidly ruin any painted or varnished surface with which it makes contact. A more serious consequence of splashes is that the developer is a serious skin and eye irritant.

Methylene chloride is an extremely volatile liquid. This means that a room containing an open tray of the developer solution would rapidly have its air contaminated with substantial amounts of the vapor. In a small bathroom with the windows and doors closed to make a temporary darkroom, the vapor concentration could far exceed the recommended peak exposure level. The present federal peak limit is 2000 ppm, but the National Institute for Occupational Safety and Health has recommended that it be substantially reduced.

Methylene chloride, which enters the body by inhalation, is rapidly metabolized. One of its breakdown products is carbon monoxide. This reacts with the hemoglobin in blood and reduces its oxygen carrying capacity. The heart and circulatory system must then work extra hard to pump blood faster in an attempt to make up for the decreased oxygen supply. Methylene chloride also affects the central nervous system as an anesthetic.

I recommend that anyone using a developer containing methylene chloride follow the general recommendations for paint removers in *Consumer Reports* (August 1976, page 434):

- "If at all possible, *work outdoors*. And try to stay upwind . . . If you must work indoors, make sure there's plenty of ventilation—not just from an open window or two, but from a strong window exhaust fan.
- "Wear neoprene rubber gloves and goggles. If you splash yourself, wash the affected area immediately with soap and water.
- "Keep children away from the work site, and store the container out of their reach."

The developing of the photoresist could easily be performed safely in the backyard after sunset. The photoresist is not so light sensitive that night background illumination would be a problem.

None of the chemicals used in this process should be stored in a refrigerator that contains food, and flammable chemicals should never be stored in any home refrigerator.

With these precautions and common sense, printed circuit boards can safely and successfully be made at home.

Jim Warner
Board of Studies in Chemistry
University of California
Santa Cruz CA 95064

The Wired OR . . . Again!

I read with interest R. W. Burhans' letter (p. 21) regarding the wired OR in the December 1977 *Kilobaud* and would like to inject some word of warning. The wired OR (or, more correctly, wired NOR), when used with TTL devices, should be used *only*, I repeat, *only* with open-collector types. The M^2L logic (I love Don Lancaster's term) or diode logic should be used *only*, I repeat, *only* with CMOS devices (which have logic levels much more forgiving than that of TTL) or if the input consists of a switch.

Anybody who follows Mr. Burhans' advice and uses diode isolated AND or OR configurations with normal (totem-pole output) TTL gates of the 7400 or 74LS family is asking for *big* trouble. The reason is simple: The worst-case low-level output voltage for gates of the 7400 family is .4 volts; for 74LS family it is .5 volts. Fast silicon diodes (like those of the 1N444X family) at a forward current of .1 mA have a static forward voltage of maximal .55 volts (these figures come from the TI manuals).

If now the output of a TTL gate is driving the input of a following gate via a decoupling diode, the low-level input voltage for this gate can be .5 plus .55 or 1.05 volts or even higher, depending on the size of the pull-up resistor. The maximum permissible low-level voltage for all devices of the 7400 and 74LS series, however, is only .8 volts. That means this arrangement operates in a voltage range that is outside of the manufacturer's specifications. The circuit *may* work sometimes, and then it may not work, depending on the whim of the ICs, power buses, temperature and phase of the moon.

That's the reason diode logic with TTL devices having a normal (totem-pole) output should *not*, I repeat, *not* be used (unless, maybe, you are using hot carrier diodes, which have a lower forward voltage but are very expensive, or germanium—remember germanium—diodes, which are slow).

Erich A. Pfeiffer
Granada Hills CA

Ralph Burhans' Reply

The critique of "The Wired OR . . . Again!" is perfectly correct in stating that use of diodes in series with normal totem-pole TTL output (not O.C.) could create problems in excessive zero voltage drop and is not recommended by chip manufacturers. However, experimenters often do what is possible and not what is recommended, particularly if the risk of failure is very small.

Before the widespread use of MSI and LSI, many of us used Don Lancaster's technique (*TTL Cookbook*, Fig. 3-18A, p. 146) where a 74154 decoder is used to address a diode ROM matrix with a lot of NOR intersections. These work quite well, and I don't recall any failures. With the 74LS138 mentioned previously, a two diode NOR with one pull-up resistor provides elegant simplicity driving a D input on a KIM 74LS145 with no problems in my limited experience with four or five different chips.

It is also correct to state that CMOS has essentially no problem . . . so where is the argument? The basic difference in our thinking is perhaps that adverbs like "no" or "only" are applied here with some judgement based on a typical case (not necessarily the worst case) and experimental trial. I built my first crystal set in 1933 and also know about germanium and use 1N695s if nothing else will work for a "quick and dirty" NOR. Many computer mods, where only a single extra input is needed, can be quickly solved with a single diode, and some of ours have been working for years with no problems.

When designing from scratch, I presently prefer CMOS, but when modifying someone's design, any trick of the trade is valid in my view. Diodes often solve a problem simpler than any other approach. Diode ANDs are still another method where input switching matrices for memory use can be implemented such as in Don Lancaster's *TTL Cookbook* (Fig. 6-27, p. 256).

Ralph W. Burhans
Athens OH

Due Credit

Just received *Kilobaud* No. 16 yesterday; the article was in there. What a good feeling, until I spotted the title block. Oh my!

new 4K EPROM board *from SWTP*

Credit needs to be given where credit is due.

new 4K EPROM board from APTEC

The goof was not in the proof copy I received because no title block was included.

Harley D. Johnson
Oregon City OR

8080 Simulator Notes

I want to commend your magazine and Lee Stork for a functional and useful program/article on the 8080 Simulator (*Kilobaud*, September 1977, p. 64). After debugging I was able to adapt this program to an Intellec 8/Mod 80, to which I have access. For the benefit of readers who have tried, or are going to try, this program, here are a few notes:

1. At address 134, the mnemonic LSI should be LXI.

2. At address 172, MVI B, 5 was necessary to send a line feed to my console output device (a CRT terminal).

3. Likewise, address 138 needed MVI B,2 to give me the proper display format.

4. At address 1FD, my ICOM FDOS II assembler creates a

```
OUTPT:  IN      1       ;GET STATUS BYTE
        ANI     4       ;MASK BYTE
        JNZ     OUTPT   ;LOOP IF NOT READY
        MOV     A,M     ;READY FOR DATA
        ANI     7FH     ;ZERO PARITY BIT
        CMA             ;INVERT BYTE
        OUT     0       ;SEND IT TO PORT 0
        DCR     B       ;DCRM. LOOP CNTR
        RZ              ;RETURN IF DONE
        INX     H       ;GET NEXT CHAR. IF
                        ;NOT DONE
        JMP     OUTPT
INP:    IN      1       ;GET STATUS
        ANI     01      ;MASK
        JNZ     INP
        IN      0
        CMA
        ANI     7FH
        RET
```

Table 1.

machine code of 41,00, rather than the necessary 41,20. This can be rectified if a space follows the A in the source of DW 'A'. It should read DW 'A '.

5. My assembler didn't like the instructions given it on addresses 210-212, it would rather have seen SPACE: DB 20H,20H,20H.

6. Similarly, address 213 assembles to 0A0D, rather than the necessary 0D0A. A source statement fix of DW 0A0DH will straighten that out.

7. As is necessary for most machines, I had to rewrite the I/O routines to conform with the Intel TTY interface card. For those of you who have an Intellec 8/Mod 80, the routines are shown in Table 1.

This program is an asset to any hobbyist or programmer who programs in 8080 assembly language.

Rick Beutnagel
Hilton NY

Score 2— For Consumer Computer

In the March 1978 issue of *Kilobaud*, a short article entitled "Consumer Computer, Inc.," appeared. This work describes software, written in North Star BASIC, capable of generating replies to billing form letters produced by large computers employed by giant corporations. The article stated that this software is running on an Imsai 8080 and is being utilized to do battle with one of the largest credit-card companies in business.

Well, the results are in, and Consumer Computer, Inc., lost a few battles but won the war. The form letters generated by the microprocessor were completely ignored by American Express and its overgrown computer system. This was anticipated, since anything short of enclosing your payment within a ton of cement is usually insufficient to allow any correspondence to escape from the batch-processing syndrome. Therefore, Consumer Computer, Inc., was overcome in its first skirmish. No billing problem was corrected and a fee for the services of Consumer Computer was certainly not collected from the firm issuing the improper billings.

Round two saw "yours truly" taking American Express to New York City's Small Claims Court. Running true to form, American Express failed to answer the summons to appear in court. This caused a judgment to be entered against American Express. The arbitrator, who calculated the amount of the judgment award, allowed an added $70 for expenses (largely Consumer Computer, Inc). Thus, Consumer Computer, Inc., won an overwhelming victory by correcting my billing difficulties and collecting $70 from "Goliath," rather than the $25 fee it was originally hoping to charge American Express for its services.

Beware Master Charge, Visa, Carte Blanche, et al—Consumer Computer is ready to pounce wherever and whenever you make the slightest error by slipping a loose bit in your overgrown computer frame.

Joseph Roehrig
Middle Village NY

"Tiger Trouble" Trouble

This letter refers to the article "Tiger Trouble" (p. 106) in the March 1978 issue. Although the calculator used was not identified, I have assumed that it is either an SR-52, TI-58 or TI-59.

The program as printed on p. 108 contains errors in syntax, especially on line 72, which calls for a function not directly executable on these machines within the number of steps allotted, and on line 63, where no error halt at a "flashing 9.999 999999 99" will occur, at least on the TI-58/59, unless an R/S is provided or flag 8 is set. Furthermore, even after all syntax is corrected for the TI-59, this program will not yield the expected result with a seed of 0.9 given on pp. 108-109.

I suggest that in future articles on TI calculator programs, you specify the calculator model for which the program is intended, and that you provide a copy of the PC-100A program-listing printout, so that no ambiguity in interpretation is possible.

David P. Leising
Grand Rapids MI

It is an SR-56 program, and I apologize for the omission. —John.

Defective Formula

In the December 1977 *Kilobaud*, p. 24, one of your correspondents suggests the formula arc sin X = ATN(X/SQR (1-X**2)). This formula has the defect that when X = 1 or -1, a division by zero is required. Also, when X is close to 1 or -1, accuracy is impaired through the loss of significant digits in forming $1-X^2$.

I suggest instead the formula arc sin X = 2 * ATN(X/(1 + SQR(1-X*X))). This formula is theoretically exact and preserves the number of significant digits. Also, X*X usually executes faster and more accurately than X**2.

The formula arc cos X = -arc sin X + (0.5 * π) holds in all cases, giving the angle between 0 and π radians.

Charles A. McCarthy
St. Paul MN

Meatless Article

The quality of articles in *Kilobaud* has always ranged from fantastic to restating the obvious, and I have no complaints about this. However, in the April issue, on pages 116, 117, I found the biggest waste of paper I have ever seen in your magazine. Jim Huffman's "Finally: 8080 Meets the Fairchild Video Game" was a farce. It was nothing more than two pages of: . . . 9023, a number not yet given in any data books . . . will release data in a month or so . . . doing something . . . should be a piece of cake . . . you could add . . . and you would be able to have . . . the schematic . . . was not available . . . at some time in the future will be invaluable. Etc. I am keenly interested in this subject and just wanted to express my disappointment.

H. J. Kuhman
Pittsburgh PA

Once in a while I really blow it, and this was one of those occasions. It was simply my enthusiasm for the subject, and that of many readers, that made me decide to run the article. Thanks for the feedback; I'll try to be more careful.—John.

A Stimulating Response

Thank you for sending our book, *Stimulating Simulations*, to a reviewer who took the time to read the text and actually put the program listings into the computer. Robert Soltysik's statements (*Kilobaud,* April 1978, p. 13), although not in complete agreement with mine, were obviously based on careful examination of the book. His objectivity was certainly a relief after I read a review of *The Devil's Dungeon* in the March issue of *Interface Age*. The *Interface Age* reviewer made statements that indicated he had not entered the program in the computer or even read the scenario carefully. Instead, he vented his hatred for computer games, The Wumpus in particular, on my poor little book, which many readers and publishers have found delightful. Thank you for employing intelligent and conscientious reviewers. The next time I want to communicate with the West Coast, it will be through your magazine.

There was one problem with the review, however. My address and the price of the book were omitted. *Stimulating Simulations* sells for $5 and can be purchased from Engel Enterprises, PO Box 16612-K, Tampa FL 33687.

Jane E. Engel
Publisher

6800 Owners: Look Out!

I recently purchased *Practical Microcomputer Programming: The M6800* by W. J. Weller, Northern Technology Books, 1977, $21.95. I am very disappointed with the book and hope you will not promote it. Here are

my complaints:

1. There are no equipment block diagrams, such as to describe programming models of the MPU, PIA or ACIA. This is a particular disadvantage when trying to describe the behavior of the peripheral chips.

2. There is no description of the hardware interrupt signals, even though there is a chapter on interrupts. Also, this chapter contains inaccurate or misleading statements.

3. The book departs from Motorola assembly language with several pseudo-ops, with some of the number base conventions and with indexed address notation.

4. The book uses no flowcharts to outline or generalize programs.

5. The chapter on floating-point arithmetic could have been written for any computer or microprocessor. It had no real how-to-do-it information and did not even mention any actual floating formats.

I feel that the book is not well organized, but this, I know, is a subjective matter.

Who am I? MSEE with ten years' experience on minis and interfacing. Owner of Altair 680 and MEK6800D2 kit. Instructor (moonlight job) on 6800 system at Midwest College of Engineering. 31 years as W9CUP.

I do like Barden's book (reviewed in January 1978 *Kilobaud*) and the *Scelbi 6800 Software Gourmet Guide and Cookbook.*

Terry A. Jackson
Lombard IL

More Articles on the 1802?

This is a brief letter of concern directed to your magazine. So far, most of the articles published deal directly with the 6800 series computers or the 8000 series computers. I agree these are popular, however, you seem to overlook the RCA CDP 1802 MPU.

Certainly a large audience exists for this computer, outcropping from the COSMAC Elf series, Netronics Elf II, COSMAC Micro tutor, UC 1800 and the COSMAC VIP. An outlay of only $100 is needed for a basic computer.

Please publish more articles for the CDP 1802 COSMAC series.

Mike Otis
Aberdeen SD

I've said it before, Mike, but you've given me the opportunity to say it again . . . and I thank you. I don't have a magic hat to reach into and pull out articles on a particular computer. We publish articles that have been written. *If you, or any other 1802 owner, would like to see more material on the 1802, then go directly to your typewriter . . . do not pass GO . . . but perhaps you will collect that $200! You're right about the 1802 gaining in popularity and I'll be happy to see more written about it.—John.*

Computer-Portraits Franchise

I read with interest your letter and reply in the letters column of December 1977 on the subject of computer portraits. We are presently setting up a franchise organization that will allow just about anyone to go into computer portraits. The franchise fee will be, not $7000 to $10,000, but only $5000 for everything, including the computer, line printer, TV camera, video monitor and software. We feel this system will have more capabilities than any other system available, and we are dedicated to continually upgrading all units in the field so it will remain so. Anyone desiring more information is invited to write me at Tri Mark Engineering, 12402 W. Kingsgate, Knoxville TN 37922.

Marshall Dudley
President

Sounds like a good topic for an article, Marshall.—John.

Demystifying the April Tic-Tac-Toe Program

I'm sorry about the errors in the Tic-Tac-Toe article appearing in the April *Kilobaud*. Basically what happened is:

1. I wrote the article before I had a printer and attempted to type the listings from my video.

2. *Kilobaud* returned a draft of the article. This draft contained numerous errors in the listing (my fault) and pages of program listing were out of order (*Kilobaud* placed page 10 in front of 9).

3. The new proof was sent to me and we still had problems. John Craig and I decided to hold publication of the article until I obtained a computer-generated listing.

4. I sent computer listings written in North Star BASIC, since I no longer had Altair equipment. This changed the article drastically.

5. We decided to go with corrected versions of the typed listing so as not to change the article.

6. In the confusion, the necessary corrections were not incorporated and one additional typesetting error was added.

I have no Altair BASIC, so I cannot supply a listing. The corrections are shown in Fig. 1.

Other answers to questions are shown in Fig. 2.

In addition to the corrections, I have attached a North Star listing of a similar game (see below).

Thanks for your understanding.

Joseph J. Roehrig
Middle Village NY

```
30  FORA=1TO3:A1=A*10:FORA2=1TO10:FORA3=0TO3
105  IFA>64OR1>ATHENPRINT'ILLEGAL MOVE':GOTO90
200  M3=-9
280  IF5>A6THENM2=M2+A6↑A6:GOTO300
320  IFM2>M3THENM3=M2:M4=A
392  A1=INT((M4-1)/16)+1:A2=M4-((A1-1)*16)
1000  PRINT'POSITIONS ARE';:FORA=0TO3:FORA1=1TO13STEP4:A2=20+(A1*4)
```

Fig. 1.

NEXTA1,A	Altair BASIC lets you end multi for loops with NEXT by listing the variable of the loops to be ended
S$(A)	Altair BASIC treats string variables similar to numeric values. Thus :

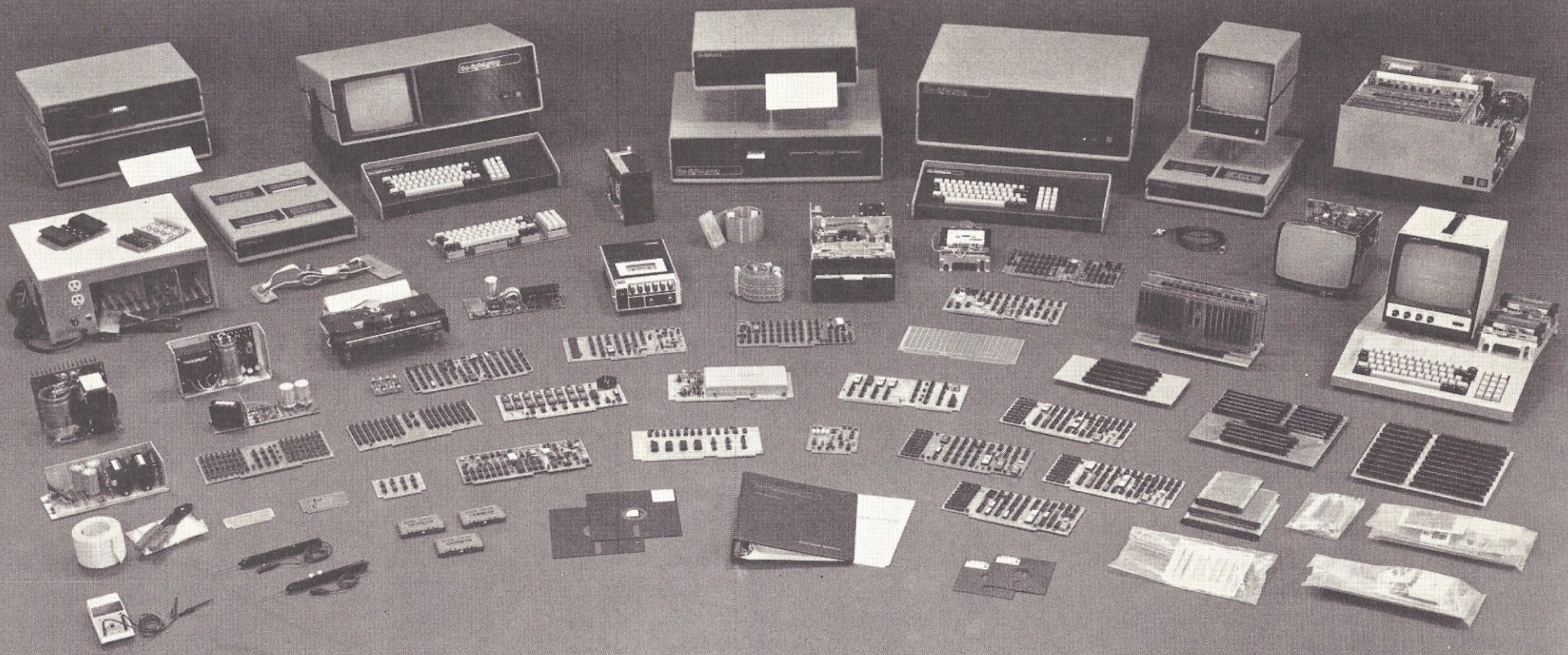
Altair S$(1) could mean 'UU' and S$(2) would be 'CC'
North Star S$(1,2) = 'UU' and S$(3,4) = 'CC'

Fig. 2.

```
10 DIMS(64),W(3,76),S$(64),V(76)
11 DIMC9(64,8)
20 FORA=1TO10\FORA1=0TO3\READW(A1,A)\NEXTA1\NEXTA
30 FORA=1TO3\A1=A*10\FORA2=1TO10\FORA3=0TO3
40 W(A3,A1+A2)=W(A3,A2)+(16*A)\NEXTA3\NEXTA2\NEXTA
42 !"HOW SHALL I PLAY ? 1=BEST 2=GOOD"
44 INPUT"                    3=FAIR 4=POOR ? ",Q9
46 IFQ9<1THENQ9=1\IFQ9>4THENQ9=4
50 FORA=41TO56\FORA1=0TO3
60 W(A1,A)=(A1*16)+A-40\NEXTA1\NEXTA
70 FORA=57TO76\FORA1=0TO3\READW(A1,A)\NEXTA1\NEXTA
72 DATA1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,1,5,9,13,2,6,10,14
74 DATA3,7,11,15,4,8,12,16,1,6,11,16,4,7,10,13,1,22,43,64
76 DATA5,22,39,56,9,26,43,60,13,26,39,52,2,22,42,62,14,26,38,50
78 DATA3,23,43,63,15,27,39,51,4,23,42,61,8,23,38,53,12,27,42,57,16,27,38,49
80 FORA=1TO64\S$=S$+" "\S(A)=0\NEXTA
83 DATA 1,21,41,61,1,18,35,52,4,19,34,49,4,24,44,64
84 DATA13,25,37,49,13,30,47,64,16,31,46,61,16,28,40,52
85 PRINT"YOUR MOVES ARE UU AND I'M CC"
86 FORA=1TO76\FORA1=0TO3\A2=W(A1,A)\A3=-1
87 A3=A3+1\IFC9(A2,A3)=0THEN89
88 GOTO87
89 C9(A2,A3)=A\NEXTA1\NEXTA
90 GOSUB1000\INPUT"YOUR BOARD, POSITION ? ",A1,A2
100 A=((A1-1)*16)+A2
105 IFA>64THEN118
107 IF1>ATHEN118
109 IFS(A)<>0THEN118\GOTO120
118 PRINT"ILLEGAL MOVE"\GOTO90
120 S(A)=1\S$(A,A)="U"
125 U2=A\U4=1\GOSUB1400
190 M5=0\FORA=1TO76
196 IFV(A)=4THEN410
198 IFV(A)=15THENM5=A
199 NEXTA\IFM5<>0THEN365
200 M3=-9
204 Y1=0
205 FORA=1TO64
```

(continued on page 110)

Nobody does it bigger!



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Taming the I/O Selectric (Part 1)

It's time to get that I/O Selectric you've been using as a typewriter and interface it to your home computer.

Photo 1. The IBM Model 731 Selectric as used in the 1014 Remote Inquiry Unit. The case has an extension on the bottom to house the solenoids, which permit remote operation of the typewriter.

IBM is no longer making the I/O Selectric and as more and more IBM systems are upgraded there will be an increasing number of these units coming onto the surplus market. I've seen several articles on interfacing the Selectric, but I believe this is one of the best. It's very likely the I/O Selectric will become more and more popular as a hard copy device for hobby systems due to its rugged construction (no comparison with an office Selectric) and the cost ($700 to $950). The Model 731, which Emerson's article is based on, is mechanically the same as the Model 735. – John.

Last spring I was just getting started in the home computer hobby. I had assembled my SWTPC M-6800 kit and was making my first attempt at programming when it became obvious that any serious work would require a hard copy output. As is the case with all computer hobbyists, I talked about it at work, and a friend offered me a surplus IBM 1014 Remote Inquiry Terminal, which contained an IBM Selectric Model 731 typewriter. So, here was my hard copy output device; all that I had to do was interface it with my computer.

Well, it's all working now, and I am very happy with it. It makes beautiful copy. Now I can type assembly listings, use my computer as a text editor and type out letters or articles like this one.

Last January I gave a talk about my Selectric Interface at a meeting of the Computer Hobbyist Group of North Texas, which was received with a lot of interest. Editor John Craig heard about it and suggested an article for *Kilobaud.* So, I am now sitting at my TVT typing words into RAM and printing them out on the Selectric.

The Selectric Interface is presented in two parts: Part one describes the hardware, and part two will cover the software.

More Than a Printer

The 1014 Remote Inquiry Terminal is of early 1960 vintage. The Selectric is mounted on a heavy steel desk, which is full of power supply, relays and diodes. I didn't have room for the desk so I removed the Selectric and discarded the relay encoder and decoder circuitry. That meant that I had to provide everything between the 6800 output and the solenoids in the Selectric. I also decided to give my hard copy printer some extra smarts by arranging for computer control of typewriter on/off, single or double spacing, all capitals or upper and lowercase letters, and automatic page formatting. This was to be done by means of non-printing control characters, as will be explained in part two.

The Mechanical Marvel

The Selectric typewriter is a mechanical marvel or nightmare, depending on whether it is working right or you are trying to understand how it works and repair and adjust it. The basic typewriter is entirely mechanical except for the electric motor and switch. The characters are selected by tilting and rotating the ball (typing element) to get the proper character in position, and then striking the ribbon and paper with it. The sequence of events goes something like this: The motor drives a pulley through a toothed belt, which drives the operational shaft on the right side of the machine. A series of clutches and cams on this shaft performs the carrier return, line feed, tab, space, back space and shift functions (more about this later). The pulley also drives the cycle shaft on the left through a clutch on the pulley. The cycle shaft drives the filter shaft and print shaft through gears and does the print function.

When you press a key, an interposer is pushed down so that it trips the cycle clutch to start the print mechanism. It is also positioned so that a blade on the filter shaft strikes it and pushes it forward. The interposers, a different one for each key, have teeth that push against six selector bails. The selector bails in turn push latches from under a latch bail that is being pushed down by cams on the cycle shaft. If the latches are left hooked, the latch bail will operate a mechanical differential mechanism that moves pulleys to pull on the steel tapes. These tapes are wrapped around two drums which rotate and tilt the type element. If the six latches are hooked, they produce rota-

tion of one unit (R1), two units (R2) and two units (R2A) to the right, and tilt of one (T1) and two (T2) units. The five-unit rotation (R5) is an exception. Latching prevents five units of rotation to the left. Combinations of these latches can then print any of the 44 characters on half of the type element (four rows with 11 characters per row). The shift operation turns the ball 180 degrees so that the characters on the other half of the ball can be printed.

Though all this may sound like a Rube Goldberg machine, it is really a carefully designed device, with interlocks to prevent improper operation if the operator presses two keys at once, or if there are other timing problems. Long trouble-free service is obtained through wear-adjusting compensation. You have to take your hat off to the Selectric designers.

You don't have to understand all this to get the point — to control the Selectric by the computer, all you have to do is provide solenoids to control the latches. Similar solenoids can control the clutches for space, back space, carrier return, line feed, tab and shift. My Selectric had all of the solenoids except for the shift. If yours doesn't, and you have a little mechanical ability, you should be able to add solenoids made from old relays. Before you start, be sure to get a copy of the service manual for your typewriter. Manuals and repair parts can be obtained through your local IBM office or through an IBM Parts Distribution Center, which, in major centers like Dallas, provide 24-hour service at fair prices.

How Many Control Lines?

There are 13 Selectric functions, so it would seem that 13 control circuits from the computer would be required to control the typewriter. However, when the typewriter is typing a character only the seven type element control functions, R1, R2, R2A, R5, T1, T2 and CK (trip the cycle clutch), and SH (shift) may be required at the same time. The next five functions, SP (space), BS (back space), CR (carrier return), IND (index = IBM for line feed) and TAB (tabulate), do not need any of the type element control functions. This allows a line-saving multiplexing scheme to be used. As shown in the circuit diagram (Fig. 1), the CK line that is always on when a character is being typed is used to control the electronic equivalent of a six-pole double-throw switch. When CK is on, the type element control functions are connected to the computer. When CK is off, the non-printing functions are connected.

The shift function must not change during a character typing operation and is provided a control line of its own so that it may be controlled separately from the other functions.

With this interface cir-

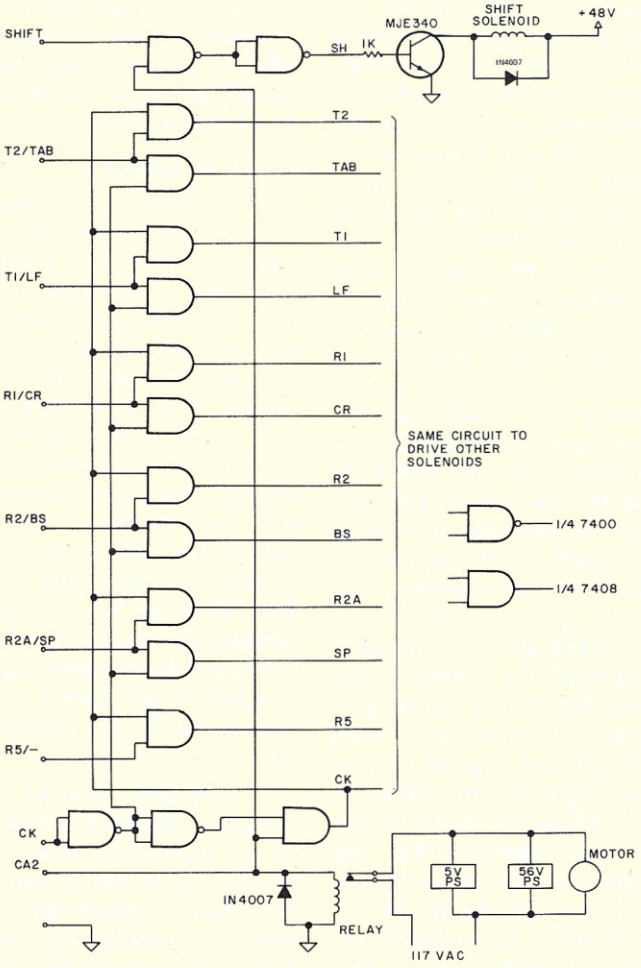

Fig. 1. Interface circuit diagram.

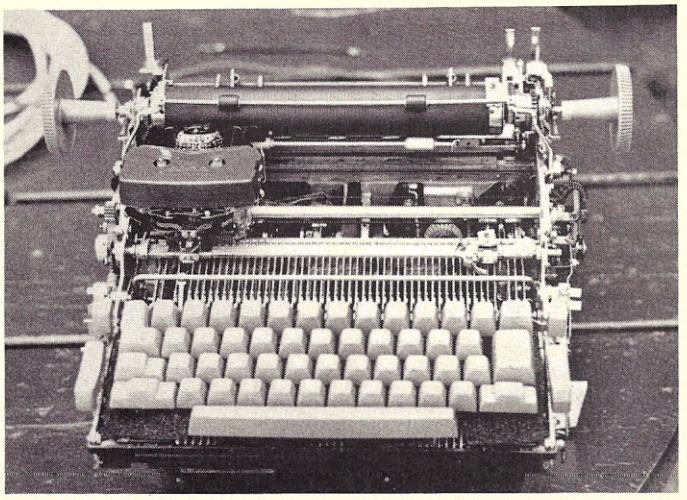

Photo 2. The type element is visible on the carrier. The carrier rides on the print shaft, which is driven by gears on the left side. The 11-inch platen has pins for paper drive.

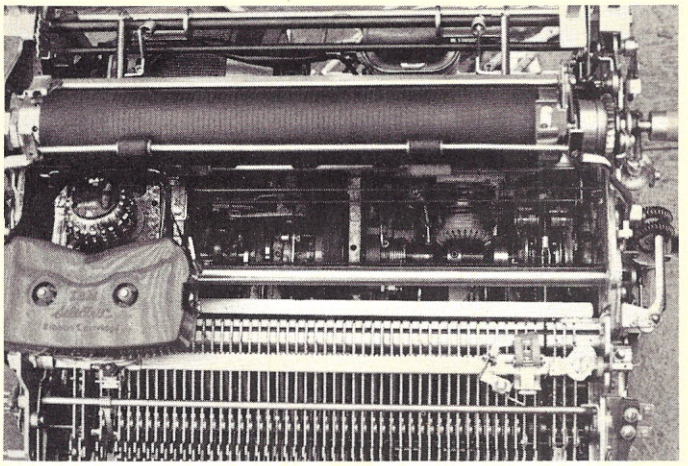

Photo 3. The belt drive is in the center of the photo. To the left of the drive pulley are the cycle clutch, five-unit cam, selector cam and reset cam on the cycle shaft. To the right is the operation shaft with the shock release clutch, carrier return clutch and pinion, tab governor and pinion, space and back space clutch and cam, and carrier return and index clutch and cam. The shift mechanism is on the right end of the operation shaft.

cuitry, all of the functions of the typewriter can be controlled. For example, to do a line feed, binary 00100000 or hex 20 should be the output to the typewriter. To type a capital A requires shift up, tilt two units and rotate left two units. The typewriter then requires binary 10100111 or hex A7. If the typewriter was in a down-shift condition, a binary 10000000 or hex 80 would be required to shift up before sending the typewriter the A7 to type A. As soon as the typewriter has started the type operation, the output should be changed to 80 to hold the up-shift condition but allow resetting of the latches to prevent typing a string of AAAAAAAA. Now, if a hyphen is to be typed, shift down, tilt three and five right rotation are required. Before typing, 00 would be sent to the typewriter to cause down shift. Then binary 00000001 or hex 01 would cause "-" to be typed. Following this pattern, you can make up a table of typewriter codes for all of the characters on the type element just by noting what shift, tilt and rotation is needed.

Turning on the typewriter and the power supplies is a little different because the switching circuit can't work with the power supply off. To get around this I used the CA2 handshake control line to directly operate a relay (Radio Shack #275-004). The power relay applies the 115 V ac to the typewriter motor, the 5 V and 56 V power supplies.

The solenoids in the typewriter require about 48 V dc at about 100 mA to operate reliably. This is too much for the usual TTL device, so a driver circuit is required. I used surplus Motorola MJE340 Darlington transistors, one for each solenoid. All of the solenoids in the typewriter were disconnected from the original circuit, and reconnected with common leads to the +56 V supply. The transistor collector was connected to the other terminal of the appropriate solenoid, with a 1N4007 diode to protect the transistor from the solenoid fly-back voltage. (A similar fly-back protection diode is provided with the power relay.) The transistors are driven directly from the TTL ICs with a series 1k Ohm resistor to limit current. The power supply is 56 V to allow for voltage drop in the transistors and supply 48 V to the solenoids.

The solenoids in the typewriter operate trip-type mechanisms – that is, when a solenoid is energized it trips a latch, and then even if the solenoid is turned off, the function is still enabled. To prevent the typewriter's being left in some unknown character condition, the CA2 line interlocks the CK and SH functions so that none of the type element control functions can be tripped while the typewriter is off.

My Selectric had no shift mechanism when I got it. Since a shift is necessary to get all the desired characters, I had to add it to the machine. I bought all the necessary parts except the solenoids from the IBM Parts Center for about $20 and used an old relay to operate the shift clutch mechanism. With this arrangement, the shift circuit must be energized whenever shift-up is required. The standard IBM shift circuit uses two latching solenoids with one being energized to trip the shift-up condition and the other to trip the shift-down condition. If your Selectric has the standard shift solenoids you will want to change the circuit shown by providing another transistor to operate the second shift solenoid and two one-shots with about 20 milliseconds on time to drive the two shift solenoids. The shift line switching on should then trigger the up-shift one-shot and when the shift line switches off the down-shift one-shot should be triggered.

The 5 V power supply is a 1 Amp regulated supply I got in a kit. The 56 V supply was made from a surplus 40 V 1 Amp transformer, bridge 1 Amp rectifiers, a surplus 1000 uF 100 V filter capacitor, but no regulator.

The interface circuitry was built on Vector .1 inch perforated circuit board and with a Vector wiring pencil and solder-through wire. All of the circuitry and power supplies were mounted on a plastic cradle in the space under the typewriter mechanism, as shown in the photo. The third transformer was required because my typewriter motor turned out to be a 208 V motor. I found a 75 V 1 Amp surplus transformer, which I connected up to boost the line voltage to 190 V, and that was high enough to make the motor start and run properly.

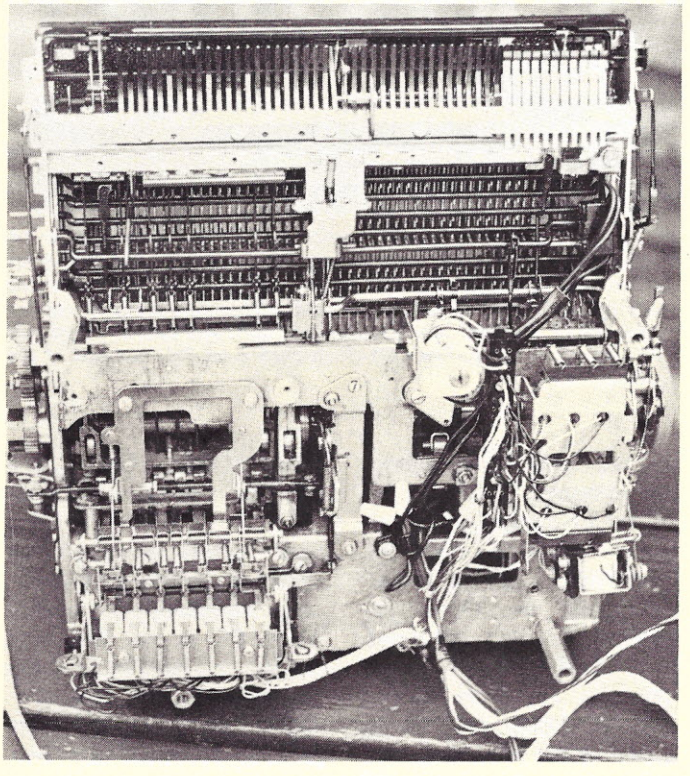

Photo 4. A view of the underside shows the seven selector solenoids at the left rear. These push the latches from under the latch bail for character selection. The vertical bars at the front under the keyboard are the interposers, and the horizontal bars are the selector bails mentioned in the text. On the right side are the five operation solenoids for space, carrier return, etc. Below these is the relay I added to trip the shift mechanism. The solenoid near the middle is a keyboard lock-out which I have not used. The typewriter mechanism sits in a plastic cradle, which serves as a mounting for the parts for the electrical interface.

Timing By Software

The Selectric had many contacts on it for use as character input to the computer and as feedback contacts for timing purposes. I had decided not to use the Selectric keyboard for two reasons. First, I felt that the TVT terminal made a more convenient input device, and second, the type element with the characters that I wanted bore no relation to keyboard arrangement. My 731 Selectric has a non-standard keyboard. Therefore I removed the character input contacts to get them out of the way and make servicing easier.

I originally thought of using the feedback contacts in a handshaking mode of operation with the computer. But then I considered the need to maintain contacts, the added interface circuitry required and the possibility

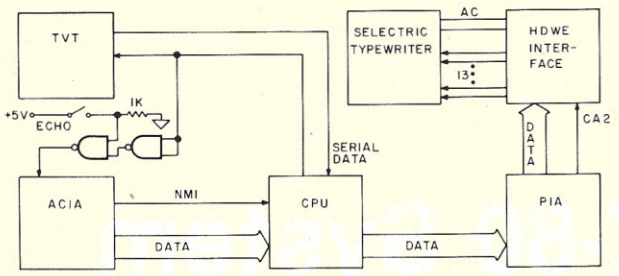

Fig. 2. System block diagram.

of the computer's hanging up waiting for a missing contact closure because of grease, dirt or other problems. Open loop software timing by the computer looked pretty good, and as it has turned out it was a trouble-free choice.

In order to do the software timing, you have to know accurately the time required for each function, or allow extra time for the uncertainty and thus slow down the output rate.

The basic timing comes from the rotation of the operational shaft, which turns at 7½ revolutions per second. When the cycle clutch is engaged to type a character it turns at the same speed as the operational shaft. The cycle shaft cams are double lobed, and so type a character in half a revolution. This means that the basic maximum typing speed is 15 characters per second (or 67 milliseconds per character), which is pretty respectable. The pull-in time for the solenoids is appreciable, about ten milliseconds. However, all of the typewriter functions are initiated by solenoids; so this common time doesn't have to be counted, as far as the software timing is concerned, because the pull-in time can overlap the completion of another function.

Shift up or shift down must be done as a separate function, and not while typing a character. A half revolution of the operational shaft is required for either shift up or shift down (1/15 second or 67 milliseconds).

Space and back space are also done in half a revolution of the operational shaft, but with a difference. The cycle and shift clutches are wrap-up spring clutches, and take hold almost instantly. The space, back space, carrier return and line feed clutches are sprocket-and-dog clutches, the sprocket having nine teeth. This means that there is a 1/9 operational shaft revolution time uncertainty or 15 milliseconds in the time for these functions. For this reason, the space and back space functions are allowed 81 milliseconds.

Line feed requires a full turn of the operational shaft and gives a time of 148 milliseconds when the clutch uncertainty is added. The time required for carrier return is dependent upon how far the carrier has to travel. I allowed 525 milliseconds for the carrier return — enough for an 80-character line.

Where Do You Plug It In?

There are ten wires going to the typewriter — eight for typing functions, one for the power relay and a common ground. These connect to an MC6820 peripheral interface adapter (PIA) in the computer: the eight control lines to the data output PIA terminals and the power relay line to the CA2 terminal. Then the computer only has to put the proper outputs to the PIA to control the typewriter.

I thought the easiest way to interface the typewriter to the program requiring hard copy output would be to have the typewriter echo what is being written on the TVT screen, thus requiring minimum modification of existing programs. The system block diagram (Fig. 2) shows how this was done.

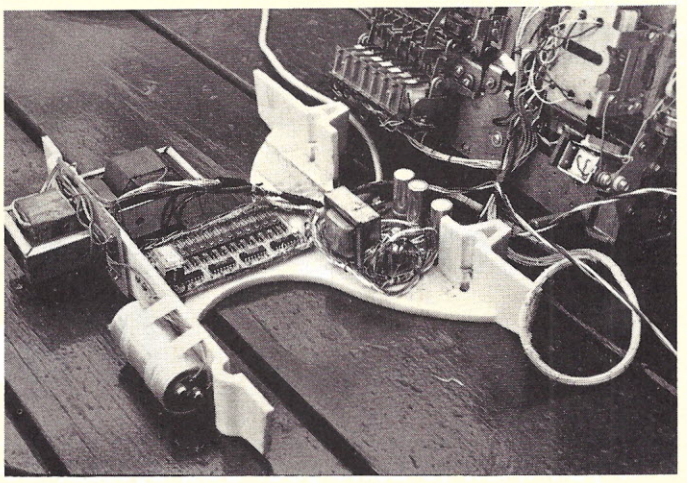

Photo 5. On the left is the 56 V power supply to operate the solenoids. The other large transformer is to adapt the 208 V motor to the 117 V power. The circuit board with the transistors, diodes, and the ICs that control the solenoids are mounted on the bottom of the cradle beneath the power relay. The 5 V power supply is at the rear.

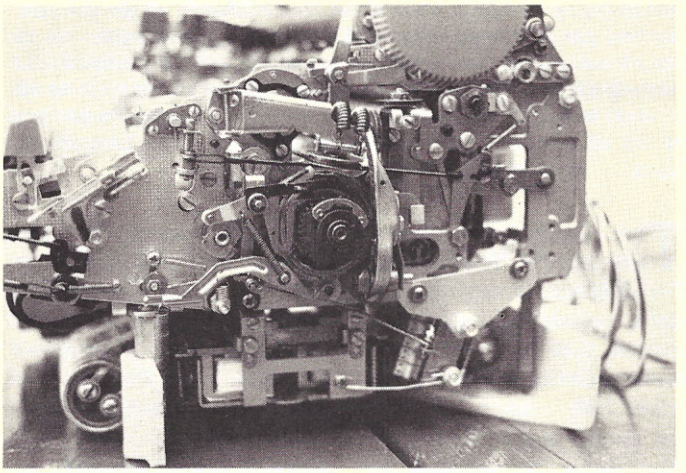

Photo 6. The shift clutch, cam, and solenoid had to be added to my machine. The shift cam pushes out the arm with the pulley on the upper end, which pulls the rotate tape to turn the type element 180 degrees.

Two NAND gates (7400) were connected in cascade, with the ECHO switch tied to one of the inputs of the second gate. The two inputs of the first gate connect to the serial data line from the computer to the TVT. When the ECHO switch is on, the output of the second gate echos the serial data going to the TVT. When that switch is off, the output is high or mark. The output is connected to the serial input terminal of an MC6850 asynchronous communications interface adapter (ACIA). With the echo switch on, when a character has been sent to the TVT and the ACIA has received it, the ACIA interrupts the computer through the nonmaskable interrupt line (NMI). The computer takes the character from the ACIA receive buffer, converts it to the proper control byte for the typewriter and puts the byte out to the PIA. After the proper time delay for typewriter operation, the computer is returned to the main program.

The software that does all of this and controls the Selectric typewriter will be described in part two of this article. ■

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James Island SC 29412

Home-Brew Z-80 System (Part 1)

If you want to build your own system from scratch, just follow these instructions.

Due to the informal nature of Kilobaud, *we don't normally provide an author's profile with each article . . . or even discuss an author's background. With Norm Thagard, I'm going to make an exception. Norm was one of 8079 applicants for America's next generation of astronauts . . . the NASA Mission Specialists who will be going into orbit aboard the Space Shuttle. When the competition got narrowed down to 208 aspirants Norm called me on the phone and told me he wanted to use the fact that he had built a home-brew computer system, and published an article on it, as additional leverage with NASA. Maybe it helped, because he was one of the 35 selected for the mission-specialist slots. Congratulations . . . and the very best to you, Norm.—John.*

The availability of several low-cost S-100-compatible Z-80 CPU boards, the high cost (for a medical student) of commercial S-100 systems and a burning desire to have a personal Z-80 system prompted me to design and construct a front panel that provides the logic to use the commercial CPU boards in an otherwise home-brew system. In my case, the S.D. Sales Z-80 CPU card was available locally and was the starting point for the design.

Lacking software experience with the Z-80, I needed a software-independent unit. Indeed, one of my major goals was to have a system with which I could develop software. The result was a manual front panel permitting direct access to memory for both read and write operations.

Armed with the Z-80 technical manual and the schematic of the S.D. Sales CPU card, I began the design. The outgrowth of the effort is depicted in this article.

Design Considerations

There were several things I especially wanted from my system: First, compatibility with the many commercial S-100 peripherals available. Since I was using the commercial CPU card, this aim was easily met—I only had to avoid compromising what was already there. Second, an expandable system—up to 64K of memory and I/O ports galore. Basically, this meant the use of Tri-state buffers in an expandable bus configuration.

Also, I wanted to use, wherever possible, standard TTL chips that I had pulled off old boards at an average cost of three or four cents. I wanted to avoid, at all costs, the use of special devices. However, in the interest of reducing bus loading and parts counts, I was willing to use some low-power Schottky packages.

I was also willing to sacrifice the dynamic refresh capability of the Z-80 to take advantage of a straightforward method of front-panel operation. This method is called direct memory access (DMA) and is readily implemented with the Z-80 MPU. Dynamic memory could still be used but would require the use of an external refresh circuit.

My home-brew TVT is entirely stand-alone with off-line capability; so I did not care that DMA by other devices, such as DMA requiring TVTs, would not be possible during front-panel operation. This would not be a serious disadvantage considering the normal reason for using the front panel, that is, for small program development and/or bootstrapping tape programs into memory. With data latches and additional logic, it would be possible to restore full DMA operation. Single-step operation is a nice feature permitting you to go through a program op code by op code. This is very handy for debugging software and, fortunately, very easily implemented.

Theory of Operation

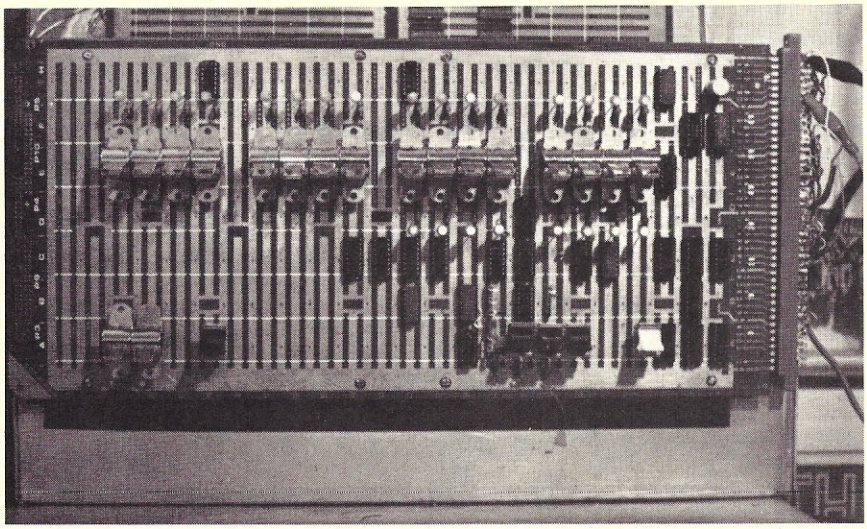
DMA is possible with a Tri-state bus system and some means to suspend MPU operation. On the Z-80 chip is a pin labeled $\overline{\text{BUSRQ}}$. It might better be named $\overline{\text{DMARQ}}$ because bringing this pin low forces the MPU to set its address, data and Tri-state output control signals to the third, or high-impedance state, thereby facilitating DMA operation. In our case, switch S3 (Fig. 1) is debounced and forces $\overline{\text{PHOLD}}$ low, which is applied through a Tri-state buffer at the CPU card to pin 25 of the Z-80 MPU (Fig. 2). As soon as the current machine cycle is ended, the MPU grants the request and acknowledges the grant by bringing $\overline{\text{BUSAK}}$ low. On the CPU card, this signal is inverted to become the S-100 signal PHLDA (DMAG or DMA grant).

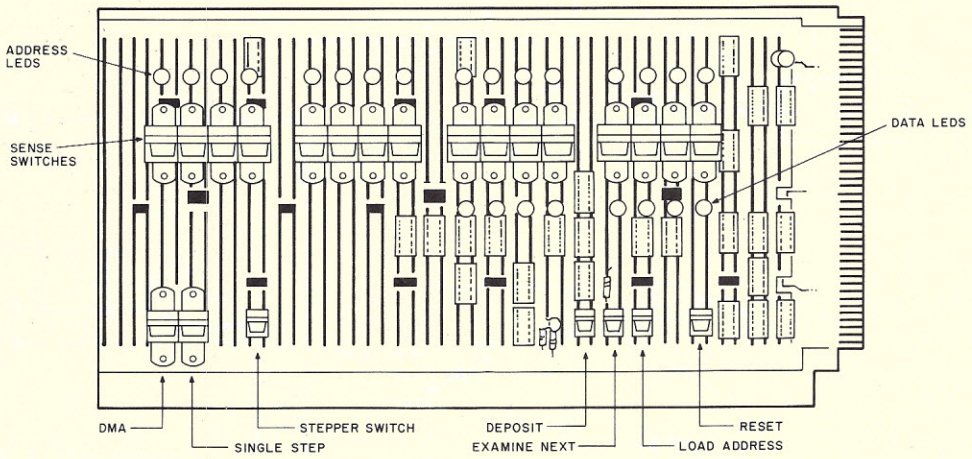
If the front panel has requested the DMA, the address bus is controlled by 74193 counters through Tri-state buffers ICs 15 to 17. At the same time, control of the data-out bus is made possible should a front-panel write operation ensue. Finally, the CPU card Tri-state buffers are disabled by the active low signals $\overline{\text{CC DSBL}}$, $\overline{\text{DO DSBL}}$, $\overline{\text{SDSBL}}$ and $\overline{\text{ADDRDSB}}$.

ICs 19 to 21 are depicted as 74LS368 Tri-state buffers, but could be 8T98 or 8098 types as direct replacements. However, the 8T98 will draw more current and the 8098 will represent a larger load to the bus. Alternatively, 7404, 7405 or 7406 types could be used with a different pin-out and higher bus loading. The 74LS04 cannot be used because it will sink only eight mA in output low state. A bit that is at logic one will cause the indicator LEDs to be forward biased and the 10 or 12 mA should give adequate light output.

To load the address, set the 16 sense switches, SS0 to SS15, to the desired location and toggle the LOAD ADDRESS switch S7. This brings the load pin on the four counters, IC11 to 14, low, which latches the address. Then this address appears at the Q outputs and at the address bus via the buffers.

To increment an address already loaded, toggle the EX-





Results of my efforts.

AMINE NEXT switch S5, which is debounced and applied through IC7a to pin 5 of IC11. Note that the increment does not occur until S5 is released. This is because the 74193 counts up on a zero-to-one transition, which does not occur until S5 is released.

Access to the data-out bus is through buffers IC17 and 18. These buffers are activated only during a write operation. After the desired address is loaded, the data is set by sense switches SS0 to SS7, which do double duty as data and low-order address byte switches. With the data set, the DEPOSIT switch S4 is activated. If DMA has been granted to the front panel, the debounced toggle passes through IC7b to IC9a, a one-shot. The one-shot places the data on the data-out bus by enabling IC17 and 18 and triggers the write pulse generator IC9b. At the end of the data-enable pulse from IC9a, the address counters are incremented automatically to access the next sequential location.

The data-in bus is continuously monitored by the inverter/LED circuitry of IC6 and 22. Here, 7404 types are used because there is little need to reduce loading on a bus that usually communicates only with the CPU.

If a program has been loaded into memory, it will execute, starting at location 0000_{16}, by returning the DMA switch to RUN and then depressing the RESET switch S6. If the CONTINUOUS/SINGLE STEP switch S1 is in CONTINUOUS mode, the execution will continue until a software HALT, 76_{16}, is encountered or DMA is requested and granted. If SINGLE STEP mode is selected, each op code must be executed one at a time by toggling the STEPPER switch S2. This switch is debounced and clocks in a logic one to the D flip-flop IC2a. This, in turn, allows $\overline{\text{PRDY}}$ to go high via IC4c and 10. $\overline{\text{PRDY}}$ communicates with $\overline{\text{WAIT}}$ on the Z-80 MPU. As long as $\overline{\text{WAIT}}$ is held low, the Z-80 will continue to "spin its wheels" by executing wait states.

Activating the STEPPER switch allows the Z-80 to resume normal operation until the next instruction-fetch cycle comes up. When this happens, the Z-80 signals the event by bringing its $\overline{\text{M1}}$ pin low. This signal appears inverted as SM1 on the S-100 bus and will trigger the one-shot IC1. In turn, IC1 clears the flip-flop once again, bringing $\overline{\text{PRDY}}$ low and throwing the Z-80 back into neutral until the next STEPPER switch toggle.

One change should be made on the S.D. Sales CPU card. IC20 should be removed from its socket. Bend pin 11 outward carefully and replace the IC (be careful that pin 11 remains outside the socket). If other Z-80 circuit boards output the machine cycle state $\overline{\text{M1}}$ on bus line D05 (S-100 bus line 39) during PSYNC, it may be necessary to disable this feature in a similar manner. Otherwise, attempts to load memory from the front panel may result in errors in bit 5 as two Tri-state devices fight each other for control of that bit.

Construction

Because of a fortuitous circumstance (low price and availability), my front panel was constructed on a large prototyping board with excellent ground and power buses. Either this sort of board or an S-100 prototyping board is recommended. If the S-100 board is used, you can simply take a standard aluminum chassis of appropriate size, mount the desired number of S-100 edge connectors on top of the chassis, hand-wire the connectors together and place the front-panel board in the forwardmost edge connector. (The pin connections on the diagrams reflect S-100 bus signals.)

A PC board is really not very practical. It would be tedious to design and would not be suited for the inevitable modifications that home-brew enthusiasts are prone to make. Wire-wrap and wiring pencil are the two techniques usually employed; I used the latter. Layout is by no means critical, and I actually used no bypass capacitors except for 50 uF electrolytics at the points where Vcc entered the board. However, good practice (according to Don Lancaster's *TTL Cookbook*) calls for one 0.01 to 0.1 uF ceramic capacitor per four gate packages or per two MSI packages. When using a wiring pencil, it is a good idea to check continuity of each interconnection with an ohmmeter.

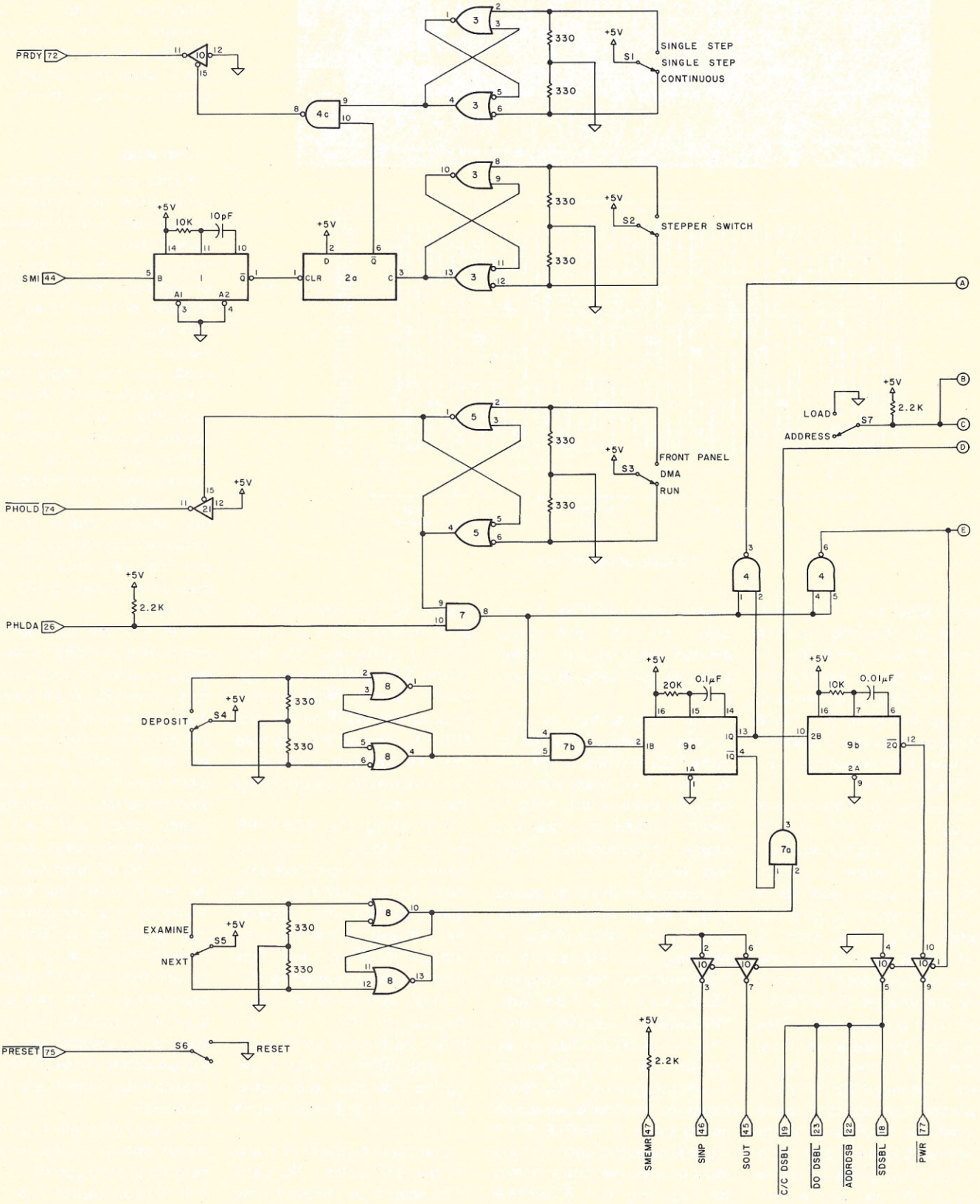
You may generally follow the layout shown in the accompanying photograph or change it to suit your own inclinations.

A word of advice: the DEPOSIT, EXAMINE NEXT and STEPPER switches will be frequently used and should be conveniently placed. The sense switches can be grouped in fours as shown for hex notation or in threes for octal. Although space requirements may tempt you to place the sense switches as close together as possible without grouping them, don't do it! With such an arrangement your error rate will be phenomenal.

Checkout

Prior to applying power, use your ohmmeter to ensure that no Vcc-to-ground short exists. The supply connections to the ICs in this project are all "at the corners," as is standard with TTL, so make sure they are connected to the appropriate bus.

With no other device in the system, power up the front panel. It should draw about 1



Amp at 5 V dc depending on how many LEDs are illuminated. With a voltmeter, check the enable pins of the Tri-state buffers of the address and data-out buses. These pins should be in the disabled or high level. If this is the case, then it should be safe to plug in the CPU and memory cards. Be sure to remove power before inserting these cards, and bear in mind that the commercial boards require +8 V dc unregulated and have on-board regulators.

You can now perform a quick checkout and run a simple program at the same time. The program will add two binary numbers and store the result in a memory location where it can be examined.

1. Set DMA switch to DMA mode and SINGLE STEP switch to CONTINUOUS mode. It may be necessary to activate the RESET switch to get a DMAG

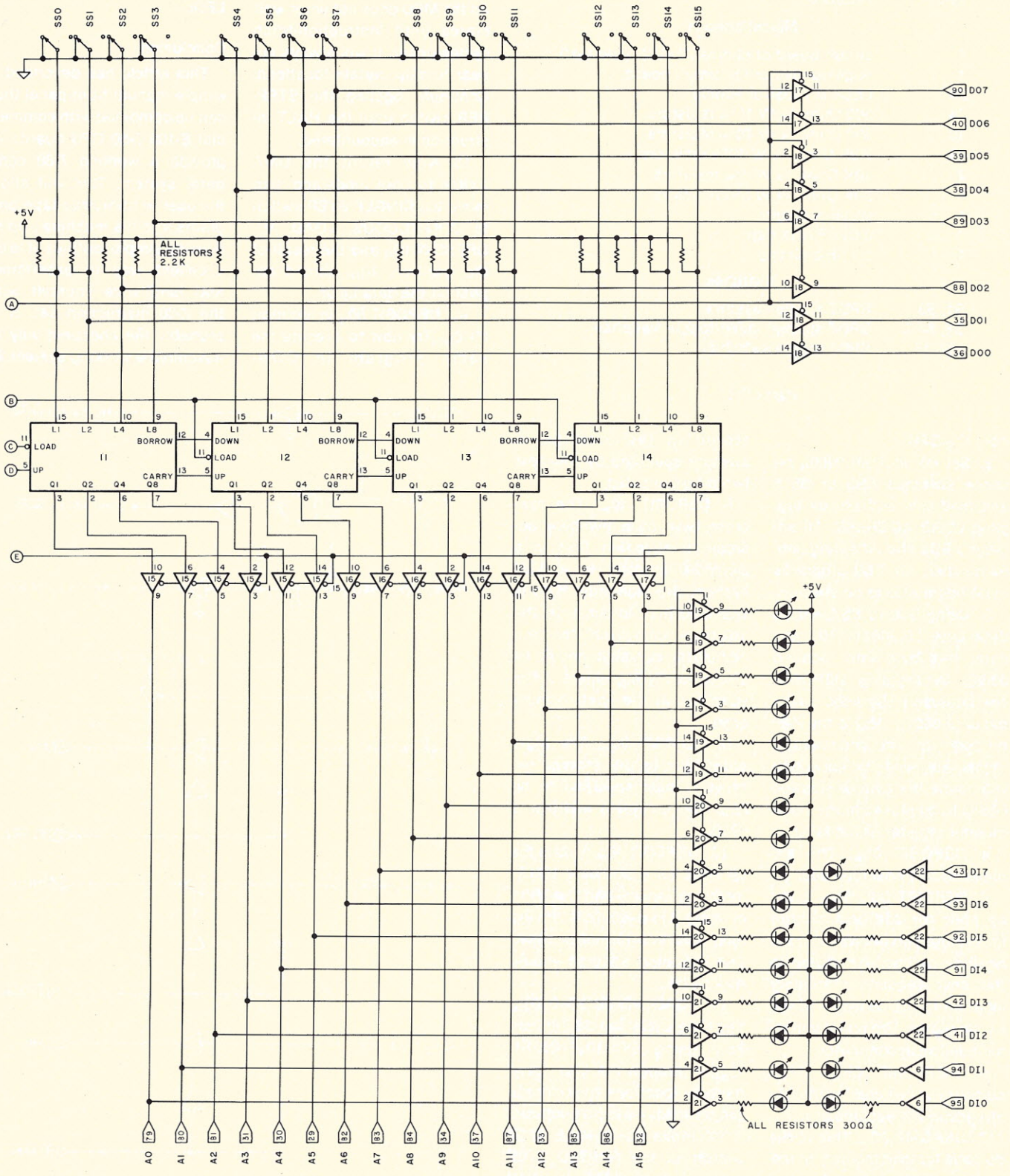


Fig. 1. Front panel.

ICs

1	74121
2	7474
3, 5, 8	7402
4	7437
6, 22	7404
7	7408
9	74123
10, 15-18	8T97
11-14	74193
19-21	74LS368

Miscellaneous

1	circuit board of choice 7" x 12" (see text)
1	edge connector for circuit board
24	LEDs MV5054 or similar
24	300 Ohm, ¼ W 10% resistors
10	330 Ohm, ¼ W 10% resistors
18	2.2K Ohm, ¼ W 10% resistors
2	10K Ohm, ¼ W 5% resistors
1	20K Ohm, ¼ W 5% resistors
1	10 pF disk cap
1	0.01 uF disk cap
1	0.1 uF disk cap

Switches

S1, S3	SPDT toggle switches
S2, S4-7	SPDT spring-loaded toggle switches
SS0-15	SPDT toggle switches

Parts list.

from the CPU.

2. Set up address 0000_{16} on sense switches SS0 to SS15 and load this address by toggling LOAD ADDRESS. All address LEDs should extinguish. Remember, all Z-80 programs must begin at zero on start-up.

3. Using SS0 to SS7, set up data byte $3E_{16}(00111110_2)$ and enter this byte into location 0000_{16} by toggling DEPOSIT. The address LEDs should now indicate 0001_{16}. $3E_{16}$ is the Z-80 op code for load accumulator immediate, and its execution will cause the byte in location 0001_{16} to be placed in the accumulator register of the MPU.

4. DEPOSIT 08_{16}. The address should now read 0002_{16}.

5. DEPOSIT $C6_{16}$. This is the op code for add accumulator immediate and will result in the addition of the byte stored in the next sequential memory location to the contents of the accumulator. The result will remain in the accumulator.

6. DEPOSIT 08_{16}. This number will be added to the 08_{16} already in the accumulator.

7. DEPOSIT 32_{16}. This is the op code for load memory immediate and will cause the contents of the accumulator to be stored in the location in memory specified by the next two program bytes.

8. DEPOSIT 10_{16}. The low-order byte of a two-byte address is specified first in a Z-80/8080 system. In a 6800 system, the high-order byte is specified first. In our case, the address in which the accumulator contents are to be stored is $XX10_{16}$, where XX is specified in the next memory entry.

9. DEPOSIT 00_{16}. The high-order byte of our storage address is now specified to be 00_{16}. The complete address is 0010_{16}.

10. DEPOSIT 76_{16}. This is the op code for a software HALT; its execution will halt the MPU, causing it to execute NOPs (no ops) until interrupted or reset. The indicated address should now be 08_{16}.

11. LOAD ADDRESS 0000_{16}. The data LEDs should indicate $3E_{16}$. Using EXAMINE NEXT, toggle through the first seven memory locations to verify the program you have just entered.

12. Place the SINGLE STEP switch in the SINGLE STEP mode, return DMA to RUN mode and activate the RESET. The address indicators will show 0000_{16} and the data LEDs will display $3E_{16}$. Activate the STEPPER switch once. The address will now be 02_{16} and data will be $C6_{16}$. Address 0001_{16} will appear to have been skipped but, in fact, will have been accessed and 08_{16} will have been loaded into the accumulator. As the MPU does not enter wait states until instruction-fetch cycles occur, it will always appear to skip certain locations. Continue toggling the STEPPER switch until the HALT instruction is encountered.

13. Now return the DMA switch to DMA mode and then move the SINGLE STEP switch to CONTINUOUS. LOAD ADDRESS 0010_{16} and the result of the addition, 10_{16}, should appear on the data LEDs.

14. DEPOSIT 00_{16} in location 0010_{16}. Try now to execute the same program in CONTINUOUS mode by moving the DMA switch to DMA and toggling RESET. The address indicator will show 0008_{16}, indicating that program execution is complete and the MPU has halted. Return the DMA switch to DMA and LOAD ADDRESS 0010_{16}. The result, 10_{16}, should once again appear on the data LEDs.

Conclusion

This article has described a simple manual front panel that can be combined with commercial S-100 Z-80 CPU boards to provide a working Z-80 computer system. This will allow the user to bootstrap tape programs into his machine and to develop simple routines. It is an excellent way to experiment and familiarize yourself with the Z-80 instruction set. It is probably the cheapest way to assemble a working system. ■

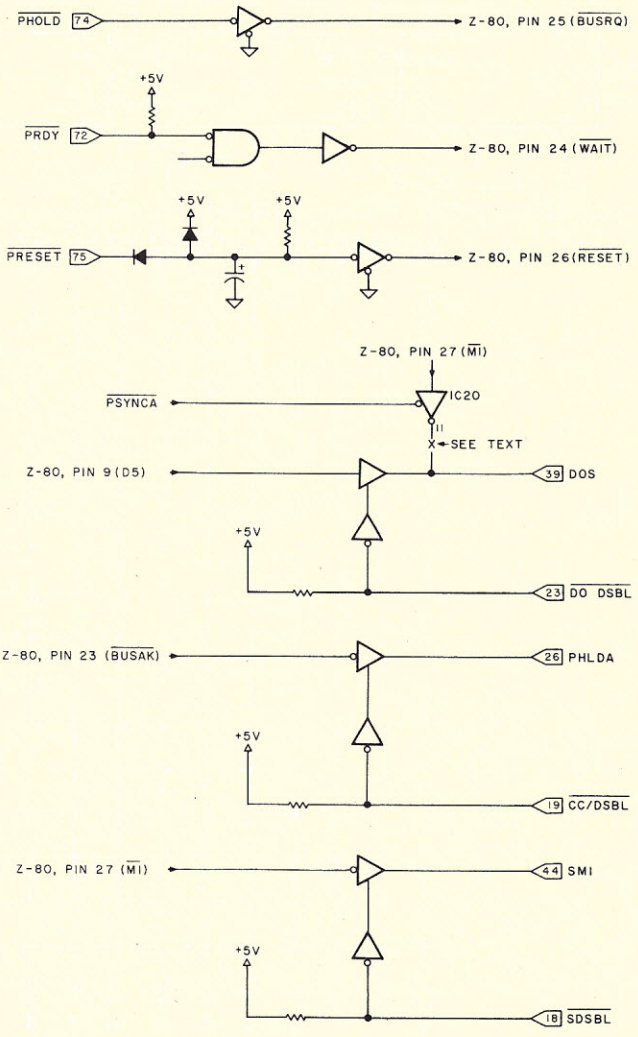


Fig. 2. S.D. Sales CPU card.

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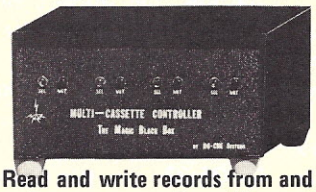

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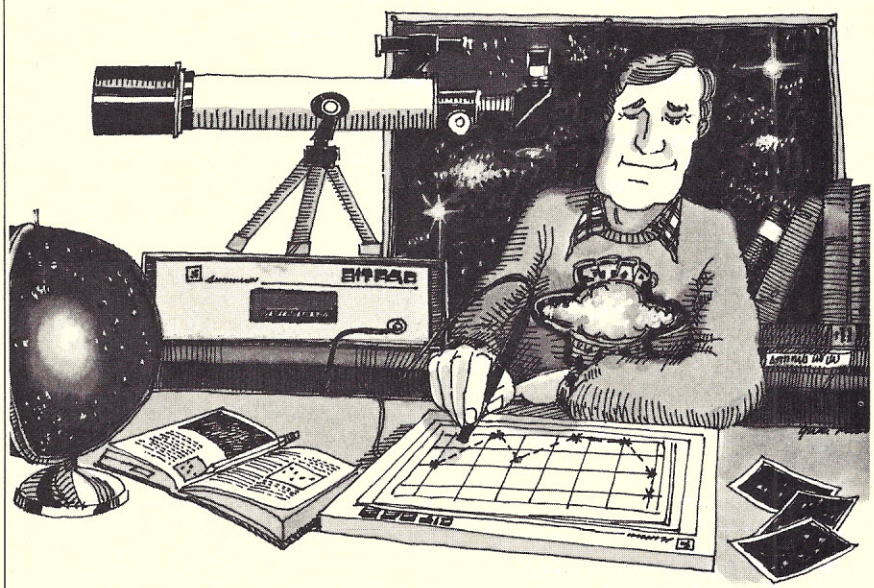

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A Strategy for Healthy Living

This computerized exercise/fitness program provides a systematic approach to getting—then staying—in shape.

Al's exerciser program has laid the groundwork for some really exciting possibilities. The next step is to have an analog-to-digital pulse counter so the computer can monitor the pulse continuously. And, along with that, speech output so the computer can tell you (as you exercise) if the pulse rate is high or low! — John.

Al Gerbens
1038 E. 6th Pl.
Mesa AZ 85203

Recently, in the process of surviving that ordeal known as a physical examination, I was introduced to a book entitled *Total Fitness in 30 Minutes A Week* by Morehouse and Gross (Simon and Schuster, NY, 1975). I later purchased a copy, read it and began following much of the advice and direction it contains. Very briefly, building and/or maintaining physical fitness is accomplished using three ten-minute exercise sessions per week. During each of these sessions you monitor your pulse rate and attempt to maintain it near a predetermined value. Each session requires more work to produce the same pulse rate as your condition improves.

Timing the segments in each ten-minute session and timing six seconds to obtain a pulse count turned out to be a pain in the neck. For example if you begin at 06.59:22 and time one minute, then you should stop at 07:00:22 and then begin timing the next two minute segment. It's now 07:02:22 and time to check pulse rate for six seconds while counting the beats. Then miltiply the pulse count by ten in order to get the rate, and begin another two-minute countdown at 07:02:37. Let's see . . . adding two minutes gives 07:04:37. . . . It's really not all that complicated until you try it while concentrating on the exercises. I thought that programming our microcomputer to assist in timing and pulse rate determination would be an interesting application. Here is the result.

```
10 INPUT"HOW MANY DATA POINTS DO YOU HAVE?",W
20 FOR Z=1 TO W
30 #"ENTER THE NUMBER OF BEATS FOR POINT";Z
40 INPUT X(Z)
50 #"ENTER THE VALUE OF T FOR POINT";Z
60 INPUT Y(Z)
70 NEXT Z
80 #"DATA ENTRY COMPLETE"
90 FOR Z=1 TO W
100 H1=LOG(X(Z))*LOG(Y(Z))
110 H=H+H1
120 J1=LOG(X(Z))
130 J3=J3+J1
140 J2=LOG(Y(Z))
150 J4=J4+J2
160 K1=LOG(X(Z))*LOG(X(Z))
170 K=K+K1
180 L1=LOG(X(Z))
190 L2=L2+L1
200 M1=LOG(Y(Z))
210 M=M+M1
220 Q1=LOG(Y(Z))*LOG(Y(Z))
230 Q=Q+Q1
240 NEXT
250 J=(J3*J4)/W
260 L=(L2*L2)/W
270 B=(H-J)/(K-L)
280 A=EXP((M/W)-((B)*(L2)/W))
290 R2=((H-J)*(H-J))/((K-L)*(Q-(M*M/W)))
300 #"B=";B
310 #"A= ";A
320 #"CORRELATION FACTOR = ";R2
330 #"USE THE FOLLOWING EQUATION FOR LINE 308 IN THE EXERCISER PROGRAM."
340 #"B1=INT(EXP((LOG(";A;"/T))/((-1)*(";B;"))))"
350 END
```

Calibration routine.

Exercise Program Functions

The program listed provides the functions of:

1. Reviewing the major concept of utilizing pulse rate as an effectiveness indicator.
2. Displaying the exercise sequence.
3. Calculating and displaying your training pulse rate based on your age.
4. Displaying that segment of exercise sequence to be accomplished next.
5. Timing each segment while displaying segment elapsed time on a video display in five-second increments.
6. Indicating when pulse rate determinations should be made.
7. Accepting 15 pulses that correspond to heartbeats, and

acting as a frequency counter calculating and displaying your pulse rate.

8. Interpreting that pulse rate and recommending an increase or decrease in the rate of activity, including taking a break. Timing of any recommended breaks is automatically accomplished and displayed.

Frequency/Pulse Rate Counter.

The pulse rate subroutine begins in line 290. When called up the subroutine watches input port one for any change from 255, which it sees if all eight lines are left

```
RUN

      EXERCISER
THIS PROGRAM PROVIDES THREE
FUNCTIONS RELATED TO THE FIRST
LEVEL EXERCISES DESCRIBED IN
-TOTAL FITNESS IN 30 MINUTES
A WEEK-BY L.E. MOREHOUSE.

THE THREE FUNCTIONS ARE
SEQUENCE, TIMING AND PULSE RATE
DETERMINATION.

TO CHECK PULSE RATE, FIRST
LOCATE YOUR PULSE BY PRESSING
AN INDEX FINGER AGAINST ONE
TEMPORAL ARTERY AT THE SIDE OF
YOUR FOREHEAD,(TEMPLE).
USING THE OTHER HAND SHARPLY
PUSH THE BUTTON IMMEDIATELY
FOLLOWING EACH HEART BEAT.
IF CORRECTLY ENTERED A SINGLE
NUMBER WILL APPEAR ON THE
SCREEN.
AVOID HOLDING THE BUTTON DOWN
TOO LONG. MULTIPLE ENTRIES CAN
RESULT.
15 BEATS WILL BE ENTERED AND
THEN YOUR PULSE RATE WILL BE
AUTOMATICALLY DISPLAYED.

THE EXERCISE SEQUENCE IS
1) LIMBERING UP(1 MIN)
2) MUSCLE BUILDUP(4 MIN)
3) CIRCULO-RESPIRATORY
   CONDITIONING (5MINS)

THE REFERENCED TEXT SHOULD BE
READ BEFORE PROCEEDING FURTHER.

WHAT IS YOUR AGE? 34
YOUR BEGINNING TRAINING PULSE
RATE IS 111 BEATS PER MINUTE.

BEGIN WITH ONE MINUTE OF LIM-
BERING EXERCISES, SUCH AS
1) STRETCHING
2) TWISTING
3) BENDING
EASY DOES IT. LIMBER UP SLOWLY.

          START
          5 SECONDS
          10 SECONDS

[ETC.]

          60 SECONDS
          ONE MINUTE

NEXT UP, 4 MINUTES OF MUSCLE
EXERCISES TO ADD MUSCLE TISSUE.
DO 15 PUSH AWAYS AND THEN 15
SITBACKS IN APPROXIMATELY THE
NEXT TWO MINUTES. THEN CHECK
YOUR PULSE RATE.

[COUNTDOWN TWO MINUTES FIVE SECONDS AT A TIME]

NOW LETS CHECK YOUR PULSE RATE.
PRESS THE BUTTON AFTER EACH
BEAT. KEEP MOVING!
PROCEED WHEN YOU ARE READY
1
2
3
[ETC.]
15
THANK YOU
RATE = 120 BEATS/MINUTE
GOOD, WITH A PULSE RATE OF
120
YOU CAN NOW REPEAT THE PUSH-
AWAY AND SITBACK EXERCISES.  15
TIMES EACH; TAKE ABOUT 2 MIN.

[COUNTDOWN TWO MINUTES FIVE SECONDS AT A TIME]

NOW LETS CHECK THAT PULSE RATE.
PRESS THE BUTTON AFTER EACH
BEAT. KEEP MOVING!
PROCEED WHEN YOU ARE READY.
1
2
[ETC.]
15
THANK YOU
RATE = 123 BEATS/MINUTE

SELECT ANY EXERCISE SUCH AS
RUNNING IN PLACE. THE OBJECTIVE
IS TO GET YOUR PULSE RATE UP TO
111 BEATS/MINUTE AND KEEP IT
THERE FOR ABOUT FIVE MINUTES.
BEGIN EXERCISING AND CHECK
YOUR PULSE RATE IN ONE MINUTE
          START

[COUNTDOWN ONE MINUTE  FIVE SECONDS AT A TIME]

PULSE RATE CHECK AGAIN
PRESS THE BUTTON AFTER EACH
BEAT. KEEP MOVING!
PROCEED WHEN YOU ARE READY
1
2
[ETC.]
15
THANK YOU
RATE = 153 BEATS/MINUTE
AT 153 BEATS/MIN. YOU SHOULD SLOW DOWN.
CUT YOUR EXERCISE RATE TO ABOUT
ONE HALF OF WHAT IT HAS BEEN
FOR THE LAST ONE MINUTE.
NOW CONTINUE EXERCISING FOR
THE NEXT TWO MINUTES.
[COUNTDOWN TWO MINUTES FIVE SECONDS AT A TIME]

TIME FOR ANOTHER PULSE RATE CHECK.
PRESS THE BUTTON AFTER EACH
BEAT. KEEP MOVING!
PROCEED WHEN YOU ARE READY
1
2
[ETC.]
15
THANK YOU
RATE = 130
LETS CONTINUE. TWO MINUTES
REMAIN IN THIS SESSION.

[COUNTDOWN TWO MINUTES FIVE SECONDS AT A TIME]

THIS SEQUENCE SHOULD BE
REPEATED THREE TIMES PER WEEK.
SEE YOU IN TWO OR THREE DAYS.
READY
```

Sample run.

Program listing (continued on following pages).

```
10 GOSUB318
12 #"      EXERCISER"
14 #"              "
16 #"THIS PROGRAM PROVIDES THREE"
18 #"FUNCTIONS RELATED TO THE FIRST"
20 #"LEVEL EXERCISES DESCRIBED IN"
22 #"-TOTAL FITNESS IN 30 MINUTES"
24 #"A WEEK- BY L.E. MOREHOUSE."
26 GOSUB314:GOSUB318
28 #"THE THREE FUNCTIONS ARE"
32 #"SEQUENCE, TIMING AND PULSE RATE"
34 #"DETERMINATION."
36 GOSUB314:GOSUB318
38 #"TO CHECK PULSE RATE, FIRST"
40 #"LOCATE YOUR PULSE BY PRESSING"
42 #"AN INDEX FINGER AGAINST ONE"
44 #"TEMPORAL ARTERY AT THE SIDE OF"
46 #"YOUR FOREHEAD. (TEMPLE)":GOSUB314
48 #"USING THE OTHER HAND, SHARPLY"
50 #"PUSH THE BUTTON IMMEDIATELY"
52 #"FOLLOWING EACH HEART BEAT."
54 GOSUB314
```

```
56 #"IF CORRECTLY ENTERED A SINGLE"
58 #"NUMBER WILL APPEAR ON THE"
60 #"SCREEN.":GOSUB314
62 #"AVOID HOLDING THE BUTTON DOWN"
64 #"TOO LONG. MULTIPLE ENTRIES WILL"
66 #"RESULT.":GOSUB314
68 #"15 BEATS WILL BE ENTERED AND"
70 #"THEN YOUR PULSE RATE WILL BE"
72 #"AUTOMATICALLY DISPLAYED."
74 GOSUB314:GOSUB318
76 #"THE EXERCISE SEQUENCE IS:"
78 #" 1) LIMBERING UP (1 MIN)"
80 #" 2) MUSCLE BUILDUP (4 MINS)"
82 #" 3) CIRCULO-RESPIRATORY"
84 #" CONDITIONING (5 MINS)"
86 GOSUB314:GOSUB318
88 #"THE REFERENCED TEXT SHOULD BE"
90 #"READ BEFORE PROCEEDING FURTHER."
92 GOSUB314:GOSUB318
94 INPUT"WHAT IS YOUR AGE? ";A
96 A1=INT(.6*(220-A))
98 #"YOUR BEGINNING TRAINING PULSE"
100 #"RATE IS ";A1;" BEATS PER MINUTE."
102 GOSUB314:GOSUB318
104 #"BEGIN WITH ONE MINUTE OF LIMB-"
106 #"ERING EXERCISES; SUCH AS:
108 #" 1-STRETCHING"
110 #" 2-TWISTING"
112 #" 3-BENDING"
114 #"EASY DOES IT. LIMBER UP SLOWLY."
116 GOSUB314:GOSUB318
118 #TAB(12);"START"
120 FORX=1T08:#"":NEXT
122 M=60:GOSUB264
124 #TAB(10);"ONE MINUTE"
126 GOSUB318
128 #"NEXT UP IS 4 MINUTES OF MUSCLE"
130 #"EXERCISES TO ADD MUSCLE TISSUE."
132 GOSUB314
134 #"DO 15 PUSHAWAYS AND THEN 15"
136 #"SITBACKS IN APPROXIMATELY THE"
138 #"NEXT TWO MINUTES. THEN CHECK"
140 #"YOUR PULSE RATE."
142 GOSUB314:GOSUB318
144 #TAB(10);"START"
146 M=120:GOSUB264
148 #"NOW LETS CHECK YOUR PULSE RATE"
150 GOSUB282
152 IF B1 >A1+20 THEN #"TAKE A MINUTE BREAKBEFORE CONTINUING."
154 IF B1 >A1+20 THEN156 ELSE164
156 #"KEEP MOVING AROUND DURING THE"
158 #"NEXT MINUTE TO IMPROVE BLOOD"
160 #"CIRCULATION":M=60:GOSUB264
162 GOTO168
164 #"GOOD, WITH A PULSE RATE OF"
166 #B1
168 #"YOU CAN NOW REPEAT THE PUSH-"
170 #"AWAY AND SITBACK EXERCISES.  15"
172 #"TIMES EACH; TAKE ABOUT 2 MIN."
174 GOSUB314
176 #TAB(10);"START":M=120:GOSUB264
178 #"NOW LETS CHECK THAT PULSE RATE."
180 GOSUB282
182 IfB1 <A1+20 THEN 192
184 #"YOUR PULSE RATE IS A LITTLE"
186 #"HIGH. TAKE A 30 SECOND BREAK"
188 #"BEFORE CONTINUING"
190 GOSUB314:M=30:GOSUB264
192 #"SELECT ANY EXERCISE SUCH AS"
194 #"RUNNING IN PLACE. THE OBJECTIVE"
196 #"IS TO GET YOUR PULSE RATE UP TO"
198 #A1;" BEATS/MINUTE AND KEEP IT"
200 #"THERE FOR ABOUT FIVE MINUTES."
202 GOSUB318
204 #"BEGIN EXERCISING AND CHECK"
206 #"YOUR PULSE RATE IN ONE MINUTE":GOSUB318
208 #"          START":M=60:GOSUB264
210 #"PULSE RATE CHECK AGAIN.":GOSUB282
212 IF B1 <A1+20 THEN224
214 #"AT";B1;" BEATS/MIN. YOU SHOULD SLOW DOWN."
216 #"CUT YOUR EXERCISE RATE TO ABOUT"
218 #"ONE HALF OF WHAT IT HAS BEEN"
220 #"FOR THE LAST ONE MINUTE."
222 GOSUB314
224 IF B1 <A1-10 THEN#"PICK UP EXERCISE RATE IN ORDER TO BRING PULSE RATE UP TO ";A1;"BEATS/MIN."
226 GOSUB314
228 #"NOW CONTINUE EXERCISING FOR"
230 #"THE NEXT TWO MINUTES."
232 GOSUB314
234 M=120:GOSUB264
```

alone. Grounding one of these lines produces an input different from 255, and the program drops into another loop. You can momentarily ground one of the port one input lines by using a push button attached to a ten-foot cord, which allows you to move around during the pulse rate determination. It is important not to stand perfectly still during this process. According to the book, passing out cold is a possible consequence of remaining still immediately following exercise, and my computer's bag of tricks does not yet include administration of smelling salts or respiration-assistance capability. Enter each heartbeat as you feel it with one hand by momentarily pushing the button with the other hand. To feel your pulse, lightly press an index finger against one of your temporal arteries (located in the temple area of your head). *Never press both arteries simultaneously.*

To help prevent multiple entries caused by holding the button down for too long, each beat is displayed on the video screen as it is recorded. Try it a few times; it won't take long to get the hang of it. If you have trouble, two solutions are potentially helpful. 1. Increase the timing of the counting loop by changing the software. 2. Add some hardware in the form of a nonretriggerable one-shot between the push button and the input port.

Counter Calibration

Each time through the counting loop, the variable T is incremented. Calibration was not as easy as I expected, however, because the relationship between pulse rate and T turned out to be nonlinear. After collecting a few data points and cranking them through linear and exponential curve fit routines, I obtained a 99.8 percent fit using the power curve $Y=AX^B$ line fit routine on an HP-65 programmable calculator. Realizing a lot of people don't have access to this resource, I've written a routine in BASIC that you can enter into your microcomputer for calibration of the counting loop on your system. Here's how to use it:

1. Enter the exerciser program, or just the counting loop if you prefer.

2. Collect three or more data points by entering known rates, which can be generated by carefully watching the sweep second hand of a clock. One pulse each second is 60 beats per minute, two pulses each second is 120 beats per minute and one pulse each two seconds is 30

beats per minute. Collect the value of T each time after the routine has counted 15 beats. Repeat each input rate about ten times and use the best eight determinations, throwing out the highest and lowest T value determination per rate.

3. Now enter the calibrating program listed with this article. It will ask you how many data points you have and then will ask you to input the values you have collected. The program then performs a line fit routine, matching the points to the general formula $Y=AX^B$, and generates a formula for a line on which the points fall. It then converts this formula into the format required in line 308 of the exerciser program. Watch R2; it is a goodness of fit value, and if it's not between .94 and 1.0, something is amiss.

4. Enter the output as line 308 in the exerciser program, and you're calibrated. Each time you enter a T value, a B1 or heartbeat rate value will be calculated using that formula.

An alternative is to collect enough data points to build a lookup table into the program or alter the counter loop to produce a linear correlation.

The program occupies about 4.5K of RAM and is written in D.G. Maxi-BASIC Version 1.0. It is running on a Digital Group Z-80 system with a 2.5 MHz clock and 18K of RAM.

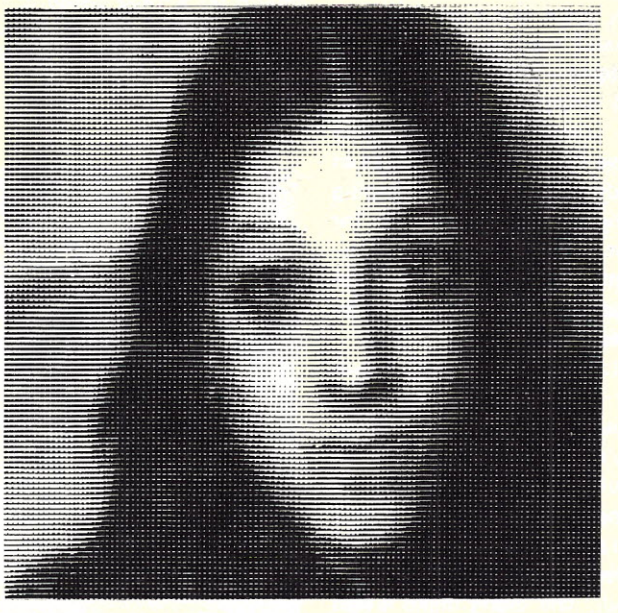
This is a unique application of a microcomputer in the home. Automatically inputting the heartbeat data using sensors such as strain gauges or force transducers is the next step. That's a hardware problem of no small magnitude at the home brew level, and would make an interesting project and article.

I strongly recommend you read and/or check with a physician before beginning any exercise program. ■

```
236 #"TIME FOR ANOTHER PULSE RATE CHECK."
238 GOSUB282
240 IF B1 >A1+20 THEN242ELSE246
242 #"BETTER SLOW IT DOWN, YOUR"
244 #"PULSE RATE IS TOO HIGH!":GOSUB314
246 IF B1 <A1-10 THEN248 ELSE250
248 #"PICK UP YOUR EXERCISE RATE!":FORX=1TO1E3:NEXT
250 #"LETS CONTINUE. TWO MINUTES"
252 #"REMAIN IN THIS SESSION."
254 M=120:GOSUB264
256 #"THIS SEQUENCE SHOULD BE"
258 #"REPEATED THREE TIMES PER WEEK."
260 #"SEE YOU IN TWO OR THREE DAYS."
262 END
264 E=O
266 FORW=1TO50
268 E=E+5
270 FORX=1TO2800:NEXT
272 #TAB(10);E;" SECONDS"
274 FORX=1TO9: #"":NEXT
276 IFE=M THEN EXIT280
278 NEXT W
280 RETURN
282 #"PRESS THE BUTTON AFTER EACH"
284 #"BEAT. KEEP MOVING!"
286 #"PROCEED WHEN YOU ARE READY"
288 T=O: B=O
290 X=INP(1)
292 IFX=255 THEN290
294 Y=INP(1)
296 T=T+1
298 IF Y <>255 THEN B=B+1
300 IF Y <>255 THEN #B
302 IF B=15 THEN306
304 GOTO294
306 #"THANK YOU"
308 B1=INT(EXP((LOG(85440.83/T))/1.2237))
310 #"RATE=";B1;"BEATS/MINUTE"
312 RETURN
314 FORX=1TO 4E3:NEXT
316 RETURN
318 FORX=1TO16:#"":NEXT
320 RETURN
```


THE MICRO WORKS

HERE'S LOOKING AT YOU, KID



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John Craig

A Tour of the Faire (Part 1)

Kilobaud's *editor, John Craig, takes a look at some of the people and products that made up the San Jose show.*

The Second West Coast Computer Faire. What a show! I always enjoy getting out for a good convention, and this one was no exception. It occurred to me that you folks who couldn't make it would also like a peek at what the show had to offer. Therefore, I took my camera along . . . and shot pictures like crazy! I sincerely hope you find it as interesting and entertaining as I did. As a matter of fact, I'd appreciate any feedback on how you feel about the effort . . . ! was a little concerned with the length.

If you're looking for software for home or small business, you'll find it here. If you're looking for the latest in mass storage, you'll find that also. Terminals? You bet. New, low-cost systems—one or two. Boards and components . . . all over the place! Finally—some of those miscellaneous pieces of hardware you've been hoping someone would develop for your system. What the heck—mention that you saw it in *Kilobaud* when you drop a line to these companies, OK?

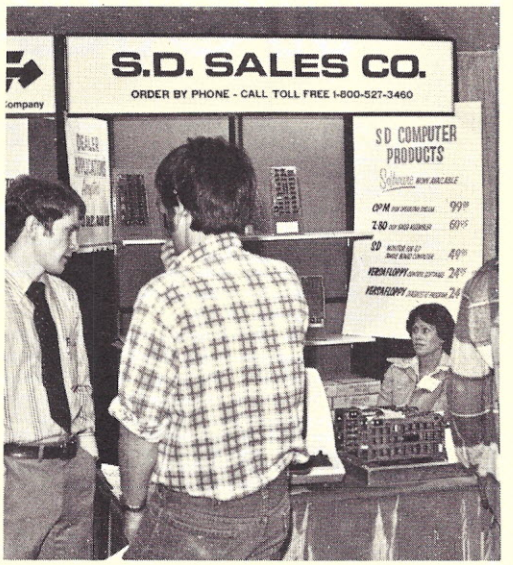
Not all is well in "photography land," I'm afraid. I shot seven rolls of film at the Faire. You're going to be seeing the results of *six* rolls . . . and I'm going to be looking for a new film processor! There are quite a few companies, large and small, who didn't make it into this write-up because of that goof—and I'm truly sorry.

Come along with me and I'll give you a grand tour of the Second West Coast Computer Faire . . . and, above all, *enjoy yourself!* ■

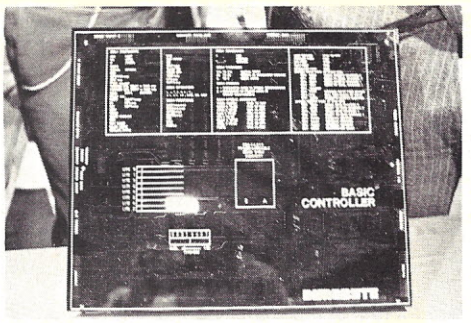
OK, TRS-80 owners, here it is: the first computer cassette "magazine." CLOAD Magazine arrives by first-class mail each month on a C-30 cassette . . . for $24 a year. Should be interesting! PO Box 1267, Goleta CA 93017.

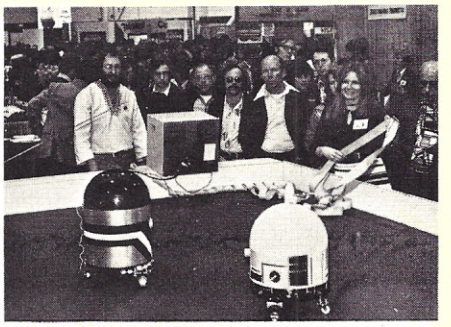
Bob Lentz, the president of Micro Works, is as pleased with the computer portrait system his company has developed as the gentleman on the left who just had his picture taken. (PO Box 1110, Del Mar CA 92014.)

Kinda show-offish, don't you think? Although it sure did the trick when it came to attracting crowds!



I keep hearing more and more good things about the service and products from S.D. Sales . . . and they sure were doing a brisk business at the Faire. Bet they'll send you their catalog if you write for it . . . or, better yet, just check their ads in Kilobaud.

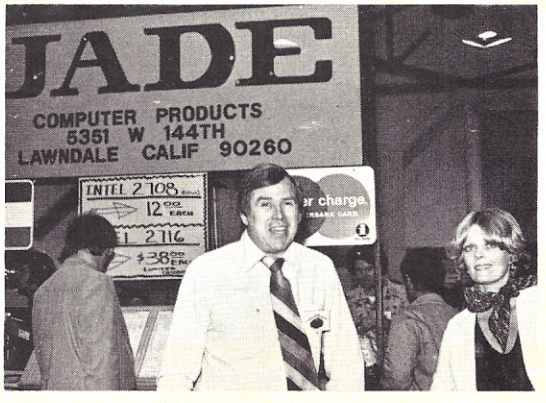




Is it Dynabyte . . . or dynamite? Let me tell you, these folks have some exciting things going! On the left we have Mike Watts, president of Dynabyte, standing in front of their Z-80 based dual minifloppy system . . . and their new double-sided, double-density Shugart floppy system. They have a rather unique dedicated-controller board (shown in the middle photo), which uses BASIC, *which is why it's called a BASIC Controller. They were using the controller to run the two robots shown in the right photo, and they sure were a hit. (I* think *it was the robots that attracted the crowds . . . but it could have just as easily been Pam Farnsworth, the young lady minding the cables and the booth.) They have several other interesting products you might want to check into . . . drop 'em a line: 4020 Fabian Way, Palo Alto CA 94303.*

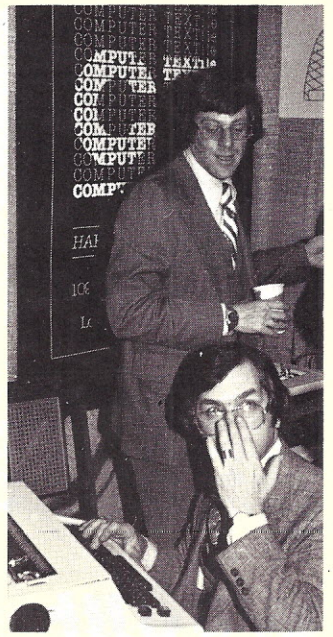
What can I say? That staid, conservative gentleman on the left is the one and only Bill Godbout! (The mood of revelry was probably due to the tremendous success of his Econoram memory boards . . . and all the other items in his catalog!) The smiling face in the center belongs to none other than Carl Warren, the Senior Editor of Interface Age. *The gentleman on the right? That's the* real *George Morrow. (Somebody who* looks *like George posed for the ad on page 128 of the April* Kilobaud, *but I know it wasn't really him because George always wears tennis shoes—and you'd never catch him with a tie on!) Godbout Electronics, Box 2355, Oakland Airport CA 94614.*

Hey, there he is. The handsome and debonair Dr. Lloyd Rice, creator of famous Computalker Voice Synthesizer. If you're in the market, give this one a listen before you buy. Computalker Consultants, PO Box 1951, Dept. K, Santa Monica CA 90406.

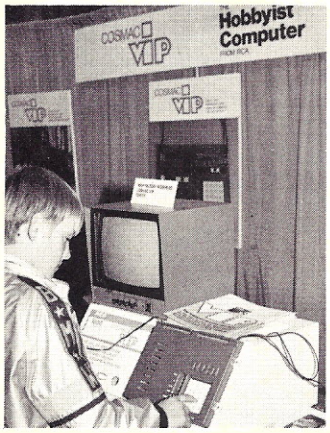


One of the busiest booths at the Faire had to be Jade Computer Products! The man behind all the action is Don Smith (shown in the center photo with his better half, Joanne). One of the latest products to be added to their line is the REX personal computer shown in the left photo. Don's "adopted son," Heath Kline, president of Priority One Electronics (10031 Woodley Ave., Sepulveda CA 91343), was sharing the booth—and showing off his MiniScope (and many other items). You cannot believe the incredible line of computer systems, components and peripherals Jade is carrying these days. Their spring catalog will make you drool! 5351 West 144th St., Lawndale CA 90260.

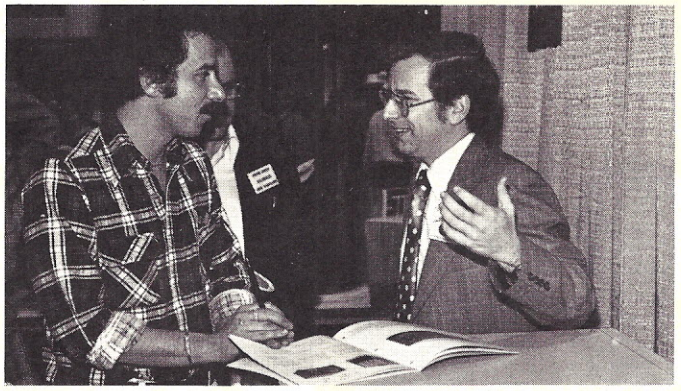
Tandy was there in force . . . with many new goodies for the TRS-80. Don French (merchandising mgr. for Tandy Computers) is behind the TRS-80 on the left. His head is directly above their new electrostatic screen printer, which sells for $599 . . . and spews out printed copy at 2200 characters per second! *They also had their new minifloppies and business systems line printer up and going (right photo). Be sure to send off for their new 1978 catalog . . . it looks like they're carrying every brand on the block! 1500 One Tandy Center, Ft. Worth TX 76102.*



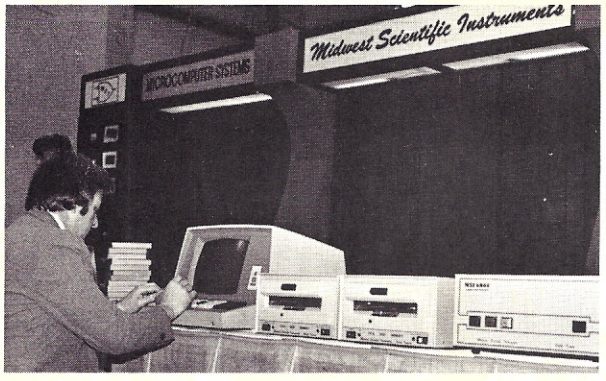
Would you buy a reconditioned Diablo ($1995) or QUME-based terminal ($2495) from that gentleman standing in the background? Sure you would, because he's Ken Widelitz, attorney-at-law, author of Kilobaud's *Legal/Business Forum and president of COMPUTER TEXTile, the company offering those terminals. 10960 Wilshire Blvd., Suite 1504, Los Angeles CA 90024.*

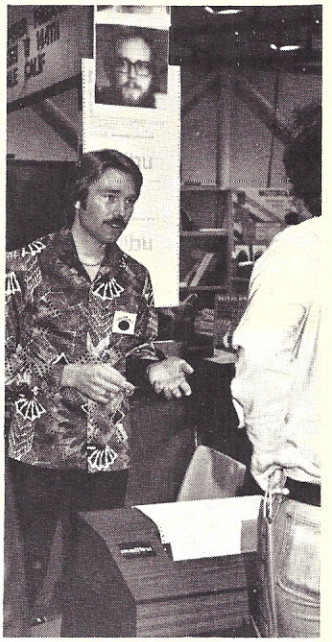


Hey, that RCA VIP (Video Interface Processor) is quite a little machine! The price is kind of high ($275 kit), but it sure is a snap to create video patterns and games. I'd sure like to see it made a little more affordable because the 1802 has a lot going for it. RCA Solid State, Box 3200, Somerville NJ 08876.



I think I really captured the flavor of the moment here. The man on the left was a serious shopper who stopped by the Cromemco booth and hit Harry Garland (president of Cromemco) with some good questions about his system. As you can see, Harry thoroughly enjoys himself when it comes to answering such questions and pointing out the merits of his system. If you're shopping around, perhaps you should check into this "Cadillac" of S-100 systems. (Send for their new Spring Microcomputers/Peripherals catalog—$1.) Cromemco, 2400 Charleston Rd., Mountain View CA 94043.





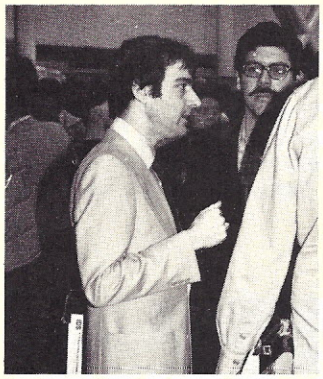
That's Mike Sherrick, the designer of the fantastic Malibu printer, and we have a review of the Malibu 160 in this month's issue. (One of their largest distributors is Jade Computer Products. Drop a line to Jade for more info.)

Dr. Curt Childress, president of Midwest Scientific Instruments, is on the left with Midwest's super 6800 system . . . and their new double-sided disk system. Curt borrowed a copy of Issue #10 of Kilobaud *and entered the Rugg/Feldman benchmarks; and he and Wayne Green are checking out the results in the photo on the right. At 1.6 MHz, the MSI 6800 came up with the following mind-blowing speeds: #1, .5 sec; #2, .5 sec; #3, 6 sec; #4, 10 sec; #5, 9 sec; #6, 12 sec; #7, 15 sec. Furthermore, the system can be run at even higher clock speeds! Their Catalog #2 is chock-full of 6800 boards, peripherals and whatever . . . send for it: 220 W. Cedar, Olathe KS 66061.*

There seems to be an abundance of S-100 disk systems hitting the market, right? Well, in the course of shopping around, be sure to look over the capacity and software being offered with the Micropolis MetaFloppy and MacroFloppy drives. Their Extended Disk BASIC has file-management and programming capabilities, and they also have a 16K DOS. 7959 Deering Ave., Canoga Park CA 91304.

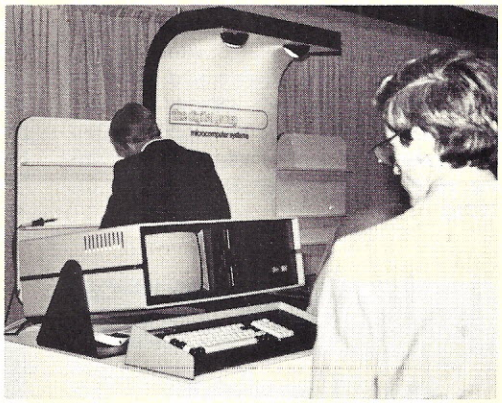
If you 6800 owners haven't checked into the line of SS-50 bus products from Smoke Signal Broadcasting then you're missing the boat! They have a DOS that supports from 1 to 3 of their minifloppies . . . patches for SWTPC BASIC . . . and a co-resident editor/assembler. They also have a 16K static memory board ($529), and more. PO Box 2017, Hollywood CA 90028.

The Digital Group was demonstrating a graphics system that made a lot of mouths water.

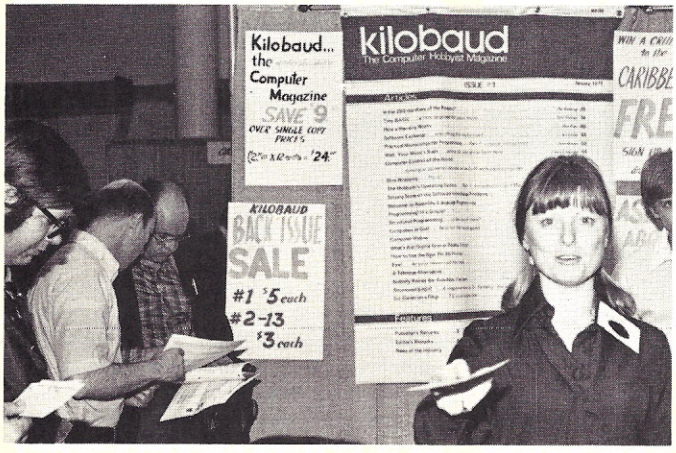


There he is, folks. The man behind the CP/M Users' Group: Tony Gold. Drop him a line . . . they've got twenty-four *volumes (diskettes) in the library at this time! 164 W. 83rd St., New York NY 10024.*

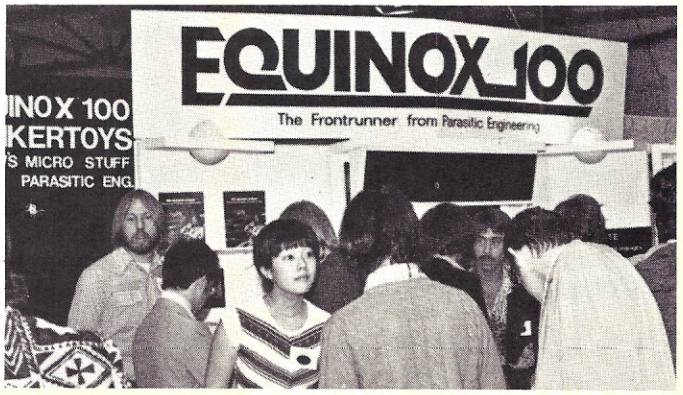
Here's the group from ALF: Greg Bloom, Philip Tubb (did you catch his "Incredizing" article in the April issue?) and Tim Gill. If you're into computer-generated music, these folks have some top-notch boards for the S-100 bus. Send for their catalog: 128 South Taft, Denver CO 80228.



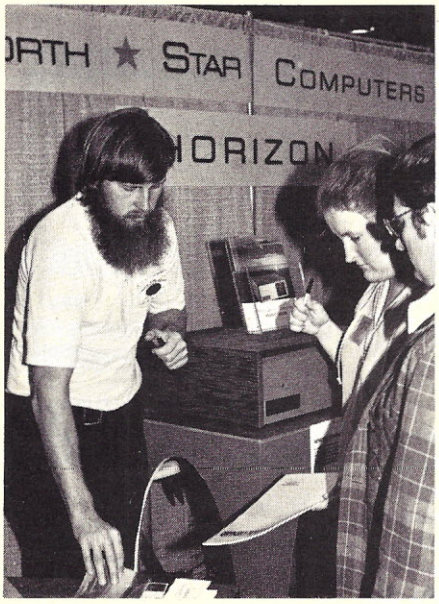
Isn't that a beauty? The new Bytemaster from the Digital Group . . . Z-80 based with either floppies (DISKMON OS) or Phi-decks (PHIMON). They have a complete *product catalog now. PO Box 6528, Denver CO 80206.*



For those of you who haven't had the opportunity to meet our executive vice-president, Sherry Smythe, then allow me to introduce her. Her son, Matt, is on the far right . . . and is one of the best booth managers in the business. (Unfortunately, we're going to have to do without his fine services for a couple of years while he goes down to Central America for some missionary work.)

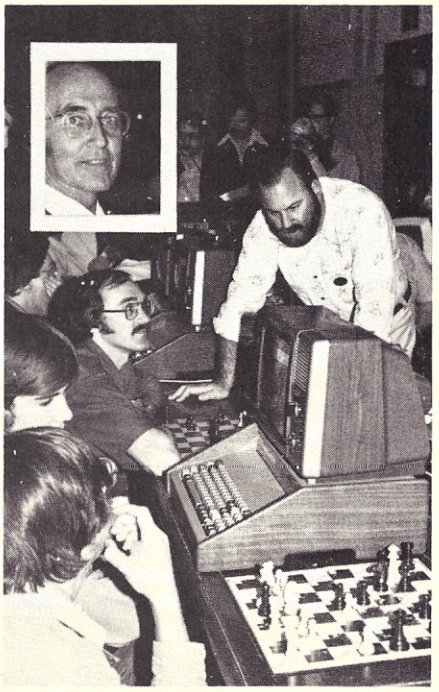


When it comes to quality S-100 systems, you're going to have to look far and wide before you find something comparable to the Equinox 100 . . . both electrically and mechanically. There were three factors that accounted for the tremendous crowds around the Thinker Toys/Parasitic Engineering booth: George Morrow's new floppy interface board, which can be configured for mini or standard-sized drives, the Equinox 100 and Lauren Kawakami. *Thinker Toys, 1201 10th, Berkeley CA 94710—Parasitic Engineering, PO Box 6314, Albany CA 94706.*



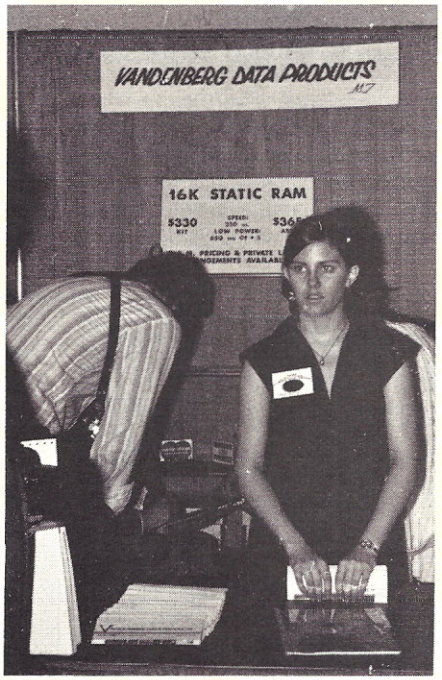
There's Chuck Grant, president of North Star Computers, with his arm resting on one of their Horizon systems. Keep your eyes open for a review of that system in an upcoming issue. With the wide-ranging use of North Star hardware and software these days, I suspect Chuck is quite pleased with what they've done. (I would have asked him, but he was too busy selling systems!) 2547 9th St., Berkeley CA 94710.

Why *is this man smiling? Because he's Lou Frenzel, director of computer marketing at Heath, and he (along with everyone else at Heath) is tickled pink at the way their systems have taken off in sales. Now their floppies are here . . . and Heath's even happier! I can't tell you who that gentleman kneeling down (eyeing their new floppy system) is, but his initials are Steve Jobs! Drop a note to Heath and ask for their new catalog: Heath Co., Benton Harbor MI 49022.*



Oh, yes . . . the chess tournament. What a crowd! I wasn't able to follow the action, but it was sure there. My friend, Doug Penrod (inset), played a big role in getting this event going through his "Computer Chess" newsletter (which will be a feature in Personal Computing *magazine in the future).*

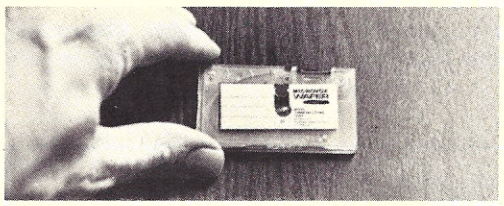
Who says the camera never lies? In this photo, Bob Mullen (guess which one) appears as a thoughtful, contemplative, handsome and debonair designer of the only S-100 logic-probe/extender board and relay/opto-isolator control board on the market; his partner, Keith Britton, appears to be awake! *(Hey, check into their* new *logic-probe/extender board. It uses a 7-segment display, and does the job nicely!) Mullen Computer Products, Box 6214, Hayward CA 94545.*

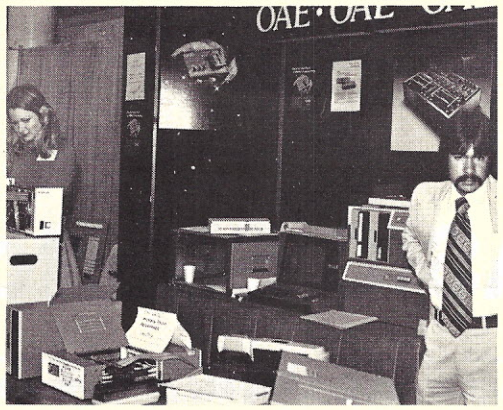


Becky Sallume, of Vandenberg Data Products, was one of the most lively "flyer-handèr-outers" at the Faire; but this photo was taken at the end of the last day! If you're in the market for a 16K S-100 board that runs cool, *then send VDP some of your hard-earned money ($330 kit; $365 assembled). PO Box 2507, Santa Maria CA 93454.*

It never fails. At almost every computer convention you have at least one person go berserk and try to hit master reset and crash a system. I guess the strain was just too much for Nancy Millikin . . . and I sure hope she felt better after hitting that button! On the serious side, if you'd like some additional info on Meca's fantastic mass-storage system (with a voice prompt and response capability) write to them at: PO Box 696, 7026 Old Woman's Spring Rd., Yucca Valley CA 92284. (Ask for their mass-storage buyer's guide.)

Wanna draw a crowd? Put up a Digital Research *sign! I don't know whether you've noticed it or not, but there are two pieces of software playing a dominating role in this microcomputer industry; Microsoft BASIC . . . and Digital Research's CP/M Operating System! Heck, you can even get CP/M for the North Star drive (Lifeboat Associates, 164 W. 83rd St., New York NY 10024) and for the ICOM Frugal Floppy (Computer Mart of New Jersey, 501 Rt. 27, Iselin NJ 08830)! Digital Research has a new macroassembler and symbolic instruction debugger, both of which will be reviewed in an upcoming issue of* Kilobaud. *Version 1.4 of CP/M is out, too. Drop them a line for more info: PO Box 579, Pacific Grove CA 93950.*



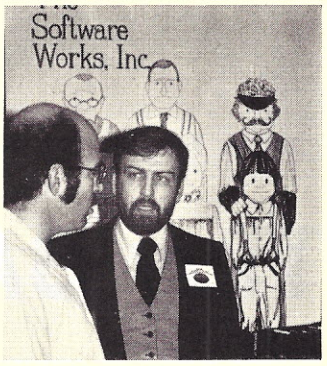


Oliver Audio Engineering was looking good! Beautiful booth . . . and normally big crowds around it! By the way, did you know their new PROM programmer simply plugs into an existing PROM socket to do it's thing (read, program, verify and duplicate)? Two models—and they both sell for $295. OAE, 676 West Wilson Ave, Glendale CA 91203.

If you're in the market for a low-cost mass-storage system, then take a look at what the folks at Exatron have come up with! It's not called a cassette . . . it's a continuous-loop tape wafer *(called the Stringy Floppy). Each wafer holds 40K bytes; and the transfer rate is an incredible 7200 kilobaud. Loads a 4K program in about 5 seconds. The system includes an S-100 controller board (with 4K monitor/assembler/editor) and the drive for $289.50. (They also have a Tiny BASIC and a 5K BASIC available.) 1030 East Duane Ave., Suite I, Sunnyvale CA 94086.*

Once again I managed to chase off the crowds for a second to grab a shot of Dan Meyer, president of Southwest Technical Products (sporting a new beard). They have a new dual-drive disk system (the DMAF1) for business applications that has a file management system called FLEX. (Oh, the drives are double-sided . . . 600K bytes each.) Send for their new catalog, and include $.25, OK? Box 32040, San Antonio TX 78284.

TSC started off in the 6800 software business, but they're now offering some of the same packages (their text processing, in particular) in 8080 code. They would dearly love to send you a copy of their new '78 catalog. Technical Systems Consultants, Box 2574, W. Lafayette IN 47906.



If that dapper gentleman looks like Dick Milewski of The Software Works, there's a good reason for the resemblance! If you're looking for a North Star-based inventory-control program, they have one. (A review of the package is coming up in Kilobaud.*) Drop them a line for more info: PO Box 4386, Mountain View CA 94040.*

Hey . . . the folks at the Computer Room have a couple of beautiful *business systems. The one Lawrence Grijalva is demonstrating in the photo is available with a cost-estimating package (for heavy-duty construction) and inventory control. They also have a Randall Data Systems machine with a BMI (Building Materials Industries) package . . . everything you need for running a lumber yard. 124 H Blossom Hill Rd., San Jose CA 95123.*

Well, that should do it for this time. We'll finish up our little tour of the Faire next month with Part 2: *more* of the people and products.—John.

Tiny BASIC Shortcuts

Tom Pittman's Tiny BASICs (6502, 1802, etc.) are somewhat limited in capabilities. This is the first of several articles discussing methods to expand those capabilities.

Charles R. Carpenter
2228 Montclair Place
Carrollton TX 75006

Writing small but useful programs in Tiny BASIC (to paraphrase Tom Pittman) is a practical reality. Getting the most out of your programs is easier if you work with the interpreter's limitations. The utility program in Fig. 1 shows how to work with some of these limitations. This program is titled "Loans," but it could be any comparison of WHAT-IF alternatives. Here's what we'll be working with (and without):

- Decimal numbers not allowed.
- Number range limited from -32768 to +32767.
- 72 characters maximum on Input lines.
- Implied statements and abbreviations to save bytes of memory.

(Note: Tom Pittman now has an experimenter's manual available that explains many of these features and how to work with them. They are not as simple as my approach. The manual is available from Itty Bitty Computers, PO Box 23189, San Jose CA 95153.)

These are not significant handicaps if you're estimating the effect of several alternatives. Round numbers are usually acceptable if you only want to get on base in some specific ball park (cliches are fun once in a while).

Byte-saving Tips

Saving bytes of memory is a practical approach if your computer has limited memory (I have 1250 bytes of free space now). Let's talk about the memory-saving part first.

Fig. 1 is an example of a program with no statement shortcuts; Fig. 2 uses all the implied and abbreviated statements possible in this Tiny BASIC interpreter. Memory in Fig. 1 is 492 bytes, an average of 17 bytes per line, while Fig. 2 uses 410 bytes for an average of 14 bytes per line. REM comments were added later and used 470 bytes.

Using implied statements causes the program to run

```
:
:LIST
10  REM  TINY BASIC FOR KIM-1
11  REM  6502 V.1K BY T. PITTMAN.
12  REM
13  REM  PROGRAMMED BY:
14  REM  C.R. (CHUCK) CARPENTER W5USJ
15  REM  2228 MONTCLAIR PL.
16  REM  CARROLLTON TX 75006
17  REM
18  REM  THESE PROGRAMS ILLUSTRATE BYTE SAVING
19  REM  TECHNIQUES IN LIMITED MEMORY SYSTEMS.
20  REM  THE FIRST PROGRAM USED 492 BYTES. THE
21  REM  OTHER USED 410 BYTES. AN INCREASE
22  REM  (OR SAVING) OF 82 BYTES. IMPLIED
23  REM  STATEMENTS AND ABBREVIATIONS ARE
24  REM  THE REASON.
25  PR
26  PR
100  PRINT"LOANS : HOW MANY -"
110  INPUT N
115  PRINT
120  LET A=0
130  PRINT"INPUT: PRINCIPAL IN HUNDREDS (P)"
140  PRINT"        RATE IN PERCENT (R)"
150  PRINT"        TIME IN YEARS (T)"
160  PRINT"        PAYMENTS IN MONTHS (X)"
170  INPUT P,R,T,X
190  LET I=P*T*R
200  LET O=100*P+I
210  LET M=O/X
220  LET A=A+1
230  PRINT
240  PRINT"LOAN NUMBER -";A;""
250  PRINT"INTEREST IS $";I
260  PRINT
270  PRINT"MONEY OWED IS $";O
280  PRINT
290  PRINT"PAYMENTS ARE $";M
300  PRINT
310  LET N=N-1
320  IF N>0 THEN GOTO 170
360  PRINT
370  PRINT"DONE"
380  PRINT
390  END
:
:
:
:
:I=0
:1 I=I+2
:2 GOSUB 1
:RUN

!226 AT 1
:END

:PRINT"THERE ARE ";I;" BYTES LEFT"
THERE ARE 288 BYTES LEFT
:
```

Fig. 1. First program version using no shortcuts to write the program or save bytes. This program uses 492 bytes, exclusive of the REM statements. REM statements use 470 bytes. The short routine above illustrates how Tiny BASIC finds the number of bytes of free space remaining. The user's manual tells how to do it.

slower, but the increase in program lines is worth the loss of speed (if speed is your concern then Tiny BASIC may not be for you, anyway). Memory saving wasn't really necessary for this short program; but in a 100-line program over 200 bytes could be saved (12 to 15 lines' worth). Such significant savings allow you to write longer programs. The programs are still small, but even a few more lines make them more useful. And that's what we're trying to do. Bytes could be saved in a few more places, such as the spaces in the print input, lines 130 through 160, but in the interest of clarity, I left them alone.

Decimal Values

Calculations involving decimal numbers can be handled several ways. Anytime a percentage or a calculation resulting in a fraction occurs, a decimal number results. Dollars and cents are decimal numbers, too. Tiny BASIC truncates decimal numbers down to the next lower whole number. If the number is less than one, the result is zero. (For this reason, accountants would probably not want to use Tiny BASIC.)

Lines 130 through 180 are the input lines for this program. I used principal in hundreds and rate in percent to avoid decimal percentage entry and to prevent dividing percent by 100 (to get back to a decimal percentage). The math comes out right when it's printed out in line 250. I then multiplied the total loan value by 100 in line 200 to make the right amount print in lines 270 and 290.

Principal input in hundreds also helps avoid the number-limitation problem. Keeping the numbers to be operated on small limits precision but keeps the multiplication results in range. Adding a statement in a print line to multiply (or divide, etc.) by some factor will put the answer back in the right magnitude. This is sort of like using engineering notation with a slide rule. The difference is the lack of decimal numbers.

An input-line limitation of 72 characters restricts the amount of data you can input. Two character spaces are used by the prompting question mark and following space. This reduces actual data input to 70 characters, including the required commas between the data entries. With the loan amount in hundreds, I was able to input values for six loans instead of five. To overcome the limited data-input situation, write programs that will perform calculations, hold the results and return for more data. I've done this on some data-processing routines with good results.

There's another way to accommodate more data than the line will hold. Simply input as many loan numbers (or WHAT-IFs) as needed in line 100. When the program has used the data entered, it will ask for more until the number of N entries is reached in line 320. Question marks will show up each time

```
:LIST

100  PR"LOANS : HOW MANY -"
110  INPUT N
115  PR
120  A=0
130  PR"INPUT: PRINCIPAL IN HUNDREDS (P)"
140  PR"        RATE IN PERCENT (R)"
150  PR"        TIME IN YEARS (T)"
160  PR"        PAYMENTS IN MONTHS (X)"
165  PR
170  INPUT P,R,T,X
190  I=P*T*R
200  O=100*P+I
210  M=O/X
220  A=A+1
230  PR
240  PR"LOAN NUMBER - ";A;""
250  PR"INTEREST IS $";I
260  PR
270  PR"MONEY OWED IS $";O
280  PR
290  PR"PAYMENTS ARE $";M
300  PR
310  N=N-1
320  IF N>0 GOTO 170
360  PR
370  PR"DONE"
380  PR
390  END
```

Fig. 2. Second program version using implied statements and abbreviations to save bytes. This version uses 410 bytes.

```
LOANS : HOW MANY -
?6

INPUT: PRINCIPAL IN HUNDREDS (P)
       RATE IN PERCENT (R)
       TIME IN YEARS (T)
       PAYMENTS IN MONTHS (X)

?40,10,3,36,40,12,4,48,40,18,5,60,50,10,3,36,50,1
2,4,48,50,18,5,60

LOAN NUMBER - 1
INTEREST IS $1200

MONEY OWED IS $5200

PAYMENTS ARE $144

LOAN NUMBER - 2
INTEREST IS $1920

MONEY OWED IS $5920

PAYMENTS ARE $123

LOAN NUMBER - 3
INTEREST IS $3600

MONEY OWED IS $7600

PAYMENTS ARE $126

LOAN NUMBER - 4
INTEREST IS $1500

MONEY OWED IS $6500

PAYMENTS ARE $180

LOAN NUMBER - 5
INTEREST IS $2400

MONEY OWED IS $7400

PAYMENTS ARE $154

LOAN NUMBER - 6
INTEREST IS $4500

MONEY OWED IS $9500

PAYMENTS ARE $158

DONE

:
```

Fig. 3. Sample run. Simple interest calculations of two different loan values at three rates.

From Fig. 3

Simple Int

Interest%	Years	Amount
1. 10	3	$5200.00
2. 12	4	5920.00
3. 18	5	7600.00

From Fig. 5

Compound Int

Equiv-Int%	Years	Amount
11	3	$5320.00
15	4	6400.00
26	5	9200.00

Mult	Actual Loan Value	Difference
1. 1.331	$5324.00	+$ 4.00
2. 1.574	$6296.00	– 104.00
3. 2.288	$9152.00	+ 48.00

Fig. 4. For a loan of $4000.

line 170 runs out of data and line 320 is still greater than zero.

This program only calculates simple interest loans. Compound-interest calculations require decimal numbers and raising numbers to some power. The multiplier for compounding over n periods is $(1+I)^n$, where I is the interest expressed as a decimal and n is the number of years (or periods).

You can use this multiplier to calculate the approximate equivalent while percentage over the term of the loan. Your calculated answer will result in a much more realistic loan evaluation. I made some of these calculations, and Fig. 4 has some examples.

In the program itself, there are no unusual or unique programming techniques. There are two counting loops—one starting at line 110 and the other at line 120. Whatever value is input for N is decremented in line 310 until the data sets, input in line 170, are used up. The counter that starts in line 120 numbers the printed output each time a pass through the program is completed.

I tried to use N to do both, but could not without using more program lines. Otherwise, this is simply a fundamental program with input between lines 100 and 170, calculations between lines 190 and 220 and output between lines 240 and 290.

Summary

It is easy to save bytes of memory if you remember to use implied statements and statement abbreviations. The user's manual for Tiny BASIC shows what is, and is not, allowed. Both the decimal number and number range limitation can be handled by using software math techniques (multipliers, dividers, engineering notation, etc.). Line input characters limited to 70 (72 with prompting question mark and space) can also be handled by programming techniques.

Remember, if you input more than a total of 72 characters in a single line, the program will stop. Nothing more will happen until you reset your system. If you have to reset and want to save the program already in memory, then reenter the interpreter at the soft entry point. The Tiny BASIC user's manual explains how to do this, too. A program does not have to be big to be useful.■

```
LOANS : HOW MANY -
?3

INPUT: PRINCIPAL IN HUNDREDS (P)
       RATE IN PERCENT (R)
       TIME IN YEARS (T)
       PAYMENTS IN MONTHS (X)

?40,11,3,36,40,15,4,48,40,26,5,60

LOAN NUMBER - 1
INTEREST IS $1320

MONEY OWED IS $5320

PAYMENTS ARE $147

LOAN NUMBER - 2
INTEREST IS $2400

MONEY OWED IS $6400

PAYMENTS ARE $133

LOAN NUMBER - 3
INTEREST IS $5200

MONEY OWED IS $9200

PAYMENTS ARE $153

DONE
```

Fig. 5. Loan value two, rerun to show the effect of compound interest on the total loan value. Compare the results with the simple interest calculation.

North Star Software

Maillist
Maillist is a general purpose mailing label program capable of producing formatted lists for tractor-fed or Xerox type labels. Maillist will also sort lists for any field.

Price $39.95 on diskette with manual/stock to 14 day delivery.

In-out driver
Dos in-out driver is designed to set up mapped memory video boards in conjunction with hard copy device. The user may switch output under software control. Any file directory may be listed while in BASIC without jumping to dos. Spacebar will stop output for line by line listings. Designed for use with 3P+S and any tv board.

Price $12.95 on diskette with manual/stock to 14 day delivery.

Register
Register is a cash register and inventory control program. The software will control a point of sale terminal and printer. It will search inventory for an item, price and ticket it. Register has provisions for min-max, automatic reorder, and critical list.

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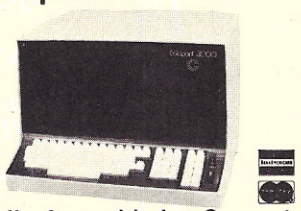

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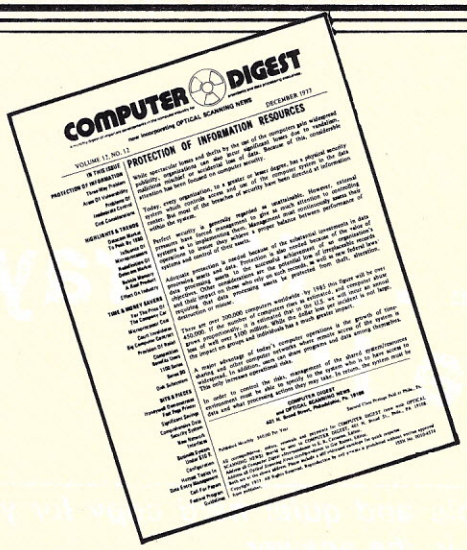
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Howard L. Nurse
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Baudot . . . er . . . Murray, Meet the H8

There is an inexpensive way of obtaining reliable and quiet hard copy for your home system; and an old five-level code teletypewriter is the answer.

Publisher's note: *The Baudot referred to in this article is actually Murray code as per my remarks on page 4. Have we all been the victim of a dastardly French revisionism plot?*

Baudot teleprinters, frequently available as surplus for next to nothing, can be used with the driver described here as a listing device for your H8 system. Baudot printers use five information bits, rather than the seven bits used by ASCII printers, to print 52 characters. Even though ASCII teleprinters can print many more characters than Baudot machines, there are only a few programming characters lacking in the five-level printer.

By assigning arbitrary symbols to cover the desirable ASCII characters not available in the Baudot set, the missing characters can be accommodated. The following assignments have been made in this driver:

Back Space	=	X
Percent (%)	=	(C)
Asterisk (*)	=	(X)
Plus (+)	=	(P)
Less Than (<)	=	(L)
Equal (=)	=	(E)
Greater Than (>)	=	(G)
At (@)	=	(A)
Left Bracket ([)	=	(B)
Reverse Slant (\)	=	(R)
Right Bracket (])	=	(B)
Up Arrow (↑)	=	(U)
Underline (_)	=	(-)

You can make arbitrary assignments by modifying the lookup table used in the driver program to convert ASCII characters generated in the computer to Baudot characters.

Integrated Circuits

U1	AY-5-1013A	UART	-12 Required on Pin 2
U1 (Alt.)	AY-3-1015	UART	-12 Not Required
U2	NE555V	Timer	
U3	SN7404N	Hex inverter	

Resistors

R 1	18k, ¼ W	
R 2	50k, 10 Turn	Potentiometer
R 3	47k, ¼ W	
R 4	1k, ¼ W	

Capacitors

C 1	.01 uF Disk Ceramic
C 2	.01 uF Polystyrene (High Stability)

Power Supply (not shown)

A power supply capable of providing +5, -12, and Loop current (if required) is necessary to operate the interface circuitry. A suitable supply, having, in addition to the above, a +12 volt regulator, loop keying transistor, transformer and solid state motor control relay, is available in fit form from Eclipse Communications, 5 Westwood Drive, San Rafael CA 94901. The RP-400 Power Supply Kit can be obtained for $71.25 (plus tax in California) plus $2 postage and handling.

Table 1. Interface parts list.

Hardware

The ASCII/Baudot driver was written for the Heath H8 computer system. This documentation assumes that the interface to the teleprinter will be made via an H8-2 parallel I/O port. Since Heath software makes no distinction between serial and parallel ports, an H8-5 serial port can be used. However, you will normally have a CRT console already connected to a serial I/O port, with the second port on the board automatically committed to the

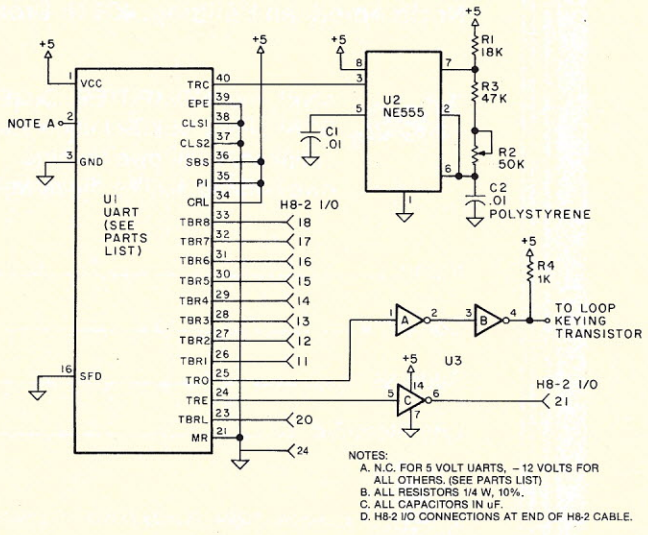


Fig. 1. H8-2 to external UART interface.

H8-2 Interface				UART Interface	
Function	*Pin*	*Wire Color*	*Signal Flow*	*Pin*	*Function*
Data 0	1	White-Black	→	11	TBR1
Data 1	2	White-Brown	→	12	TBR2
Data 2	3	White-Red	→	13	TBR3
Data 3	4	White-Orange	→	14	TBR4
Data 4	5	White-Yellow	→	15	TBR5
Data 5	6	White-Green	→	16	TBR6
Data 6	7	White-Blue	→	17	TBR7
Data 7	8	White-Violet	→	18	TBR8
Ground	9	White-Gray		24	GND
Data Taken	10	Red-Black	←	21	TRE
Take Data	11	Red-Yellow	→	20	TBRL
Device Cntrl	12	Red-Green			
Device Rdy	13	White-Black-Red			
Device Cntrl	14	Pink			
Send Data	15	Tan			
Data Sent	16	White			
Ground	17	Gray			
Data 7	18	Violet			
Data 6	19	Blue			
Data 5	20	Green			
Data 4	21	Yellow			
Data 3	22	Orange			
Data 2	23	Red			
Data 1	24	Brown			
Data 0	25	Black			

Table 2. H8-2 to UART interface.

cassette tape I/O. A second serial I/O board could be used, but an unusable tape I/O port would result.

A universal asynchronous receiver transmitter (UART), hex-inverter integrated circuit, Baudot clock and 60 mA loop circuitry are required to complete the interface. A schematic and parts list for this outboard circuitry are given in Fig. 1 and Table 1, respectively.

The baud-rate potentiometer, R2, should be adjusted to a frequency 16 times the teleprinter baud rate. If the teleprinter has 60 wpm gears, the clock rate should be 727 Hz; if the machine has 100 wpm gears, the baud-rate clock should be adjusted to 1187 Hz.

Table 2 shows the connections that must be made between the interface circuitry and the H8-2 parallel I/O connector. The parallel I/O cable is wired as recommended by the H8-2 parallel I/O manual for the H10 tape reader/punch. Finally, the jumpers on the parallel I/O channel should be configured in the same way as for an H10.

Software

The ASCII/Baudot driver uses a lookup table to convert the ASCII character being sent to the system console to a Baudot character compatible with a five-level teleprinter. The routine is placed at the upper end of user RAM, just below the stack, where provisions have been included in Heath software to allow user memory space.

The Heath software must be reconfigured to allow the ASCII/Baudot driver to be used. The changes include: (1) redefining the high-memory limit as detailed in Table 3; (2) changing five memory locations in each Heath program, as shown in Table 4.

Once the Heath software has been reconfigured, the ASCII/Baudot routine is loaded with the Heath program. The ASCII/Baudot driver need only be loaded once when going from one Heath reconfigured pro-

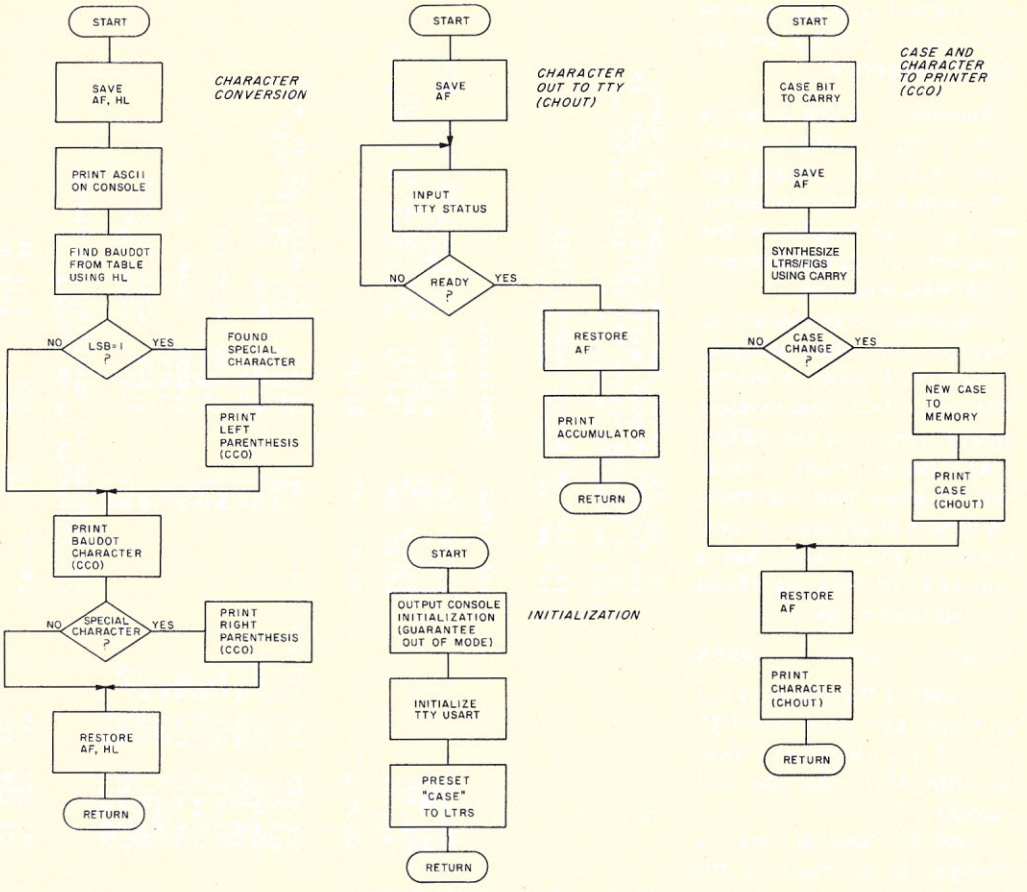
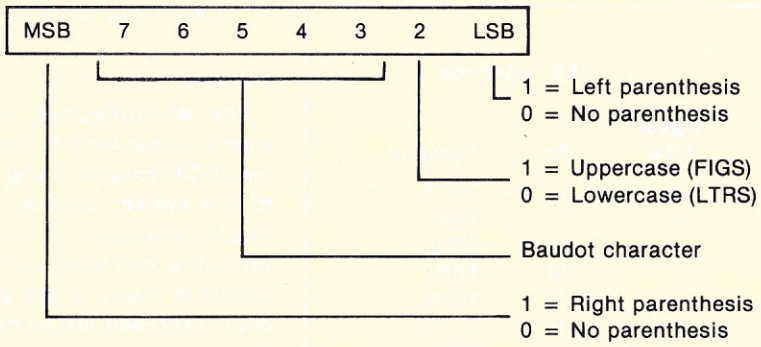


Fig. 2. Program flowcharts.



Examples:

1. Assume A is the ASCII character.
   Binary byte for A is 00001100.
   Octal equivalent of binary byte is 1400.
   Baudot machine prints A.
2. Assume = is the ASCII character.
   Binary byte for = is 10000101.
   Octal equivalent of binary byte is 2050.
   Baudot machine prints (E).
3. Assume 5 is the ASCII character.
   Binary byte for 5 is 01000010.
   Octal equivalent of binary byte is 1020.
   Baudot machine prints 5.

Fig. 3. Lookup table byte structure.

gram to another. For example, the following describes a typical use of the driver with the H8 editor and assembler.

1. Load ASCII/Baudot driver from cassette tape.
2. Load reconfigured H8 editor.
3. Push GO. The Baudot printer will now print each character sent to the CRT, with substitutions where required.
4. Write and/or edit source code.
5. Save source code on cassette tape.
6. Load reconfigured H8 assembler.
7. Push GO. The assembly will proceed normally, with all information printed on the Baudot teleprinter.

Flowcharts for the driver are given in Fig. 2, while the complete assembly listing (as printed by a model 28 teleprinter) is given in Program A. The program requires approximately 270 RAM locations.

The driver can be easily modified to be compatible with your H8 system. Program A will run with 16K of RAM. If your system differs from this, the BEGIN EQU statement must be modified to reflect your high-memory limit in offset octal. For example, if your system has a total of 8K of RAM, the BEGIN EQU statement would be:

```
BEGIN    EQU    76000A
```

from Table 3. If you wish to use an output port other than 70O, the TTY EQU statement must be changed to the new port number.

Once you have defined the changes to be made to the ASCII/Baudot driver, the source-code listing can be changed

1. Load Distribution Tape.
2. Change High Memory using Reconfigured High Memory below.
3. Change Pad from 4 to 1 (optional).
4. Record Heath program using "SAVE."
5. Proceed to instructions on Table 4.

Total User RAM	Actual Decimal Limit	Actual Octal Limit	Begin Equ	Reconfigured High Memory
4K	12287	057377A	056000A	11775
8K	16383	077377A	076000A	15871
12K	20479	117377A	116000A	19967
16K	24575	137377A	136000A	24063
20K	28671	157377A	156000A	28159
24K	32767	177377A	176000A	32255
28K	36863	217377A	216000A	36351
32K	40959	237377A	236000A	40447

Table 3. Reconfiguring Heath programs.

```
                        (X) THE FOLLOWING PROGRAM ALLOWS A STANDARD
                        (X) 5-LEVEL BAUDOT TELEPRINTER TO BE USED AS
                        (X) A LISTING DEVICE FOR SOFTWARE USING THE
                        (X) H8 CONSOLE DRIVER, V 1.1.

                        (X) THIS H8 ASCII/BAUDOT DRIVER
                        (X) WAS WRITTEN BY HOWARD L. NURSE.

                        (X) SYMBOLIC CONSTANTS:

                        BEGIN   EQU     136000A 511 BYTES BELOW HI MEM
                        TTY     EQU     0700    TTY PORT
                        $CDOUT  EQU     40111A  H8 CONSOLE DATA OUT
                        $CISO   EQU     40117A  H8 CONSOLE IN STATUS OUT

                        START   ORG     BEGIN

136.000 315 117 040     INIT    CALL    $CISO   GUARANTEE OUT OF MODE
136.003 323 071                 OUT     TTY(P)1 SAME FOR TTY PORT
136.005 076 100                 MVI     A,1000  RESET USART
136.007 323 071                 OUT     TTY(P)1
136.011 076 116                 MVI     A,1160  MODE SET
136.013 323 071                 OUT     TTY(P)1
136.015 076 005                 MVI     A,0050  COMMAND SET
136.017 323 071                 OUT     TTY(P)1
136.021 076 037                 MVI     A,370   CASE TO LTRS
136.023 062 153 136             STA     CASE    STORE SAME
136.026 311                     RET

                        (X) SAVE ACTIVE REGISTERS AND OUTPUT
                        (X) CHARACTER TO H8 CONSOLE.

136.027 365             ENTRY   PUSH    PSW     SAVE AF
136.030 345                     PUSH    H       SAVE HL
136.031 315 111 040             CALL    $CDOUT  CONSOLE CHARACTER

                        (X) CONVERT ASCII CHARACTER USING TABLE.

136.034 041 154 136     TABLE   LXI     H,TBL   ESTABLISH POINTER
136.037 205                     ADD     L       OFFSET POINTER BY ASCII
136.040 322 044 136             JNC     COK     NO CARRY AFTER ADD
136.043 044                     INR     H       WAS CARRY AFTER ADD
136.044 157             COK     MOV     L,A     COMPLETE TABLE ADDRESS
136.045 176                     MOV     A,M     GET BAUDOT CHRCTR
136.046 017                     RRC             IF SPECIAL CHARACTER
136.047 334 122 136             CC      LFT       PRINT LEFT PARENTHESIS
136.052 315 070 136             CALL    CCO
136.055 346 040                 ANI     40O     IF NOT A SPECIAL CHRCTR
136.057 312 065 136             JZ      DONE      EXIT
136.062 315 132 136             CALL    RGT     SPECIAL CHRCTR REQUIRES
136.065 341             DONE    POP     H         RIGHT PARENTHESIS
136.066 361                     POP     PSW     RESTORE HL AND AF
136.067 311                     RET
```

Program A. Assembly listing.

```
                                (X) CASE AND CHARACTER OUT TO PRINTER.
136.070  017           CCO      RRC             START CASE CHECK
136.071  365                    PUSH    PSW     SAVE SHIFTED CHARACTER
136.072  076 303                MVI     A,3030  SYNTHESIZE CASE
136.074  077                    CMC             INVERT CARRY
136.075  027                    RAL             AND SHIFT LEFT
136.076  027                    RAL             AGAIN
136.077  027                    RAL             ONCE MORE
136.100  041 153 136           LXI     H,CASE  POINT TO CASE
136.103  276                    CMP     M       IS IT SAME AS BEFORE?
136.104  312 115 136           JZ      CASOK   YES, SO EXIT
136.107  062 153 136           STA     CASE    NO, SO FIX MEMORY
136.112  315 140 136           CALL    CHOUT   AND SEND IT TO PRINTER
136.115  361           CASOK    POP     PSW     RESTORE AF
136.116  315 140 136           CALL    CHOUT   AND PRINT CHARACTER
136.121  311                    RET

                                (X) SEND LEFT PARENTHESIS.

136.122  365           LFT      PUSH    PSW     SAVE AF
136.123  076 037                MVI     A,370   LEFT PARENTHESIS
136.125  315 070 136           CALL    CCO     PRINT SAME
136.130  361                    POP     PSW     RESTORE AF
136.131  311                    RET

                                (X) SEND RIGHT PARENTHESIS.

136.132  076 045       RGT      MVI     A,450   RIGHT PARENTHESIS
136.134  315 070 136           CALL    CCO     PRINT SAME
136.137  311                    RET

                                (X) SEND CHARACTER TO PRINTER AFTER
                                (X) CHECKING STATUS.

136.140  365           CHOUT    PUSH    PSW     SAVE AF
136.141  333 071       STAT     IN      TTY(P)1 GET STATUS
136.143  017                    RRC             IS USART READY?
136.144  322 141 136           JNC     STAT    IF NOT, WAIT
136.147  361                    POP     PSW     RESTORE AF
136.150  323 070                OUT     TTY     PRINT CHARACTER
136.152  311                    RET

136.153                CASE     DS      1       LTRS/FIGS STATUS MEMORY

                                (X) BIT 0, IF 1, YIELDS LEFT PARENTHESIS
                                (X) BIT 1, IF 1, YIELDS UPPER CASE (FIGS)
                                (X) BITS 2 - 6 ARE BAUDOT CHARACTER
                                (X) BIT 7, IF 1, YIELDS RIGHT PARENTHESIS

136.154  000           TBL      DB      00      BLANK
136.155  020                    DB      200
136.156  020                    DB      200
136.157  020                    DB      200
136.160  020                    DB      200
136.161  020                    DB      200
136.162  020                    DB      200
136.163  026                    DB      260     BELL
136.164  164                    DB      1640    BS (PRINTS 'X')
136.165  020                    DB      200
136.166  010                    DB      100     LINE FEED
136.167  020                    DB      200
136.170  020                    DB      200
136.171  040                    DB      400     CARRIAGE RETURN
136.172  020                    DB      200
136.173  020                    DB      200
136.174  020                    DB      200
136.175  020                    DB      200
136.176  020                    DB      200
136.177  020                    DB      200
136.200  020                    DB      200
136.201  020                    DB      200
136.202  020                    DB      200
136.203  020                    DB      200
136.204  020                    DB      200
136.205  020                    DB      200
136.206  020                    DB      200
136.207  020                    DB      200
136.210  020                    DB      200
136.211  020                    DB      200
136.212  020                    DB      200
136.213  020                    DB      200
136.214  020                    DB      200     SPACE
136.215  066                    DB      660     !
136.216  106                    DB      1060    "
136.217  122                    DB      1220    #, OR USE 3210 (H)
136.220  046                    DB      460     $, OR USE 2450 (D)
136.221  271                    DB      2710    PERCENT (C)
136.222  152                    DB      1520    &, OR USE 3610 (M)
136.223  056                    DB      560     '
136.224  076                    DB      760     (
136.225  112                    DB      1120    )
136.226  365                    DB      3650    ASTERISK (X)
136.227  331                    DB      3310    PLUS (P)
136.230  062                    DB      620     ,
136.231  016                    DB      160     -
136.232  162                    DB      1620    .
136.233  166                    DB      1660    /
136.234  132                    DB      1320    0
136.235  136                    DB      1360    1
136.236  116                    DB      1160    2
136.237  006                    DB      60      3
136.240  052                    DB      520     4
136.241  102                    DB      1020    5
136.242  126                    DB      1260    6
136.243  036                    DB      360     7
136.244  032                    DB      320     8
136.245  142                    DB      1420    9
136.246  072                    DB      720     :
136.247  172                    DB      1720    ;
136.250  311                    DB      3110    LESS THAN (L)
136.251  205                    DB      2050    EQUAL (E)
136.252  351                    DB      3510    GREATER THAN (G)
136.253  146                    DB      1460    ?
136.254  215                    DB      2150    AT (A)
136.255  014                    DB      140     A
136.256  144                    DB      1440    B
136.257  070                    DB      700     C
136.260  044                    DB      440     D
136.261  004                    DB      40      E
136.262  064                    DB      640     F
136.263  150                    DB      1500    G
136.264  120                    DB      1200    H
136.265  030                    DB      300     I
136.266  054                    DB      540     J
136.267  074                    DB      740     K
136.270  110                    DB      1100    L
136.271  160                    DB      1600    M
136.272  060                    DB      600     N
136.273  140                    DB      1400    O
136.274  130                    DB      1300    P
136.275  134                    DB      1340    Q
136.276  050                    DB      500     R
136.277  024                    DB      240     S
136.300  100                    DB      1000    T
136.301  034                    DB      340     U
136.302  170                    DB      1700    V
136.303  114                    DB      1140    W
136.304  164                    DB      1640    X
136.305  124                    DB      1240    Y
136.306  104                    DB      1040    Z
136.307  345                    DB      3450    LEFT BRACKET (B)
136.310  251                    DB      2510    REVERSE SLASH (R)
136.311  345                    DB      3450    RIGHT BRACKET (B)
136.312  235                    DB      2350    UP ARROW (U)
136.313  217                    DB      2170    UNDERLINE (-)

136.314                        END     START
```

and the program reassembled.

Lookup Table

The lookup table contains one data byte per ASCII character. Each byte contains the five-bit Baudot character to be printed plus three control bits. As shown in Fig. 3, the least significant bit in the byte is 1, if the character is one of the special Baudot characters that will be enclosed in parentheses. If the second bit in the byte is 1, the Baudot character will be shifted to uppercase (FIGS). If the most significant bit in the byte is 1, a right parenthesis will be printed after the Baudot character. Several examples of typical characters are given in Fig. 3.

Minor keyboard variations from one printer to another may require you to alter your lookup table. Machines in common use include those having Telex, TWX, Weather, Military Standard and International Alphabet #2 character sets. Stay away from Weather machines since their character set contains many inapplicable uppercase weather symbols. The differences in the remaining four character sets are summarized in Table 5.

Upper-Case	Telex	TWX	Military	International #2
B	?	5/8	?	?
C	:	WRU	:	:
D	WRU	$	$	WRU
F	$	¼	!	NA
H	#	NA	STOP	NA
J	BELL	,	'	BELL
K	(	½	(	(
L	)	¾	)	)
S	'	BELL	BELL	'
Z	"	"	"	+

Table 5. Differences in common Baudot character sets.

1. Load tape prepared using instructions from Table 3.
2. Note Stop Address.
3. Change contents of five memory locations using Table below.
4. Reenter Stop Address noted above.
5. Put new tape in record cassette machine.
6. Push "DUMP."
7. You now have a tape containing a program, the Editor, for example, which has a new High Memory point (to protect the ASCII/Baudot Driver), a new Pad, and five changes in the I/O Driver portion to provide jumps into the ASCII/Baudot Driver routines. Note that this has taken two load and dump procedures.

Memory Address	Was	Change To	Comments
040365A	111O	027O	ENTRY LO
040366A	040O	"BEGIN" HI*	ENTRY HI
041040A	303O	315O	CALL
041041A	117O	000O	INIT LO
041042A	040O	"BEGIN" HI*	INIT HI

*Use high byte of BEGIN EQU from Table 3. For example, if your H8 has 16K of RAM, you would use 136O at memory locations 040366A and 041042A.

Table 4. Modifying Heath I/O driver.

CRT displays allow use of the back-space function (ASCII control H), while most printers do not. Since it is desirable to tell when a back space has occurred, the character X is printed each time you back space. If, during an edit, you made a mistake and back spaced to correct it, the following would be printed:

MISTOKEXXXAKE

When listed a second time, the spelling would be correct.

All ASCII characters not covered by normal and special equivalents in the table will cause a space character to be printed. Note that lowercase alphabetic characters are not included in the table, although they can be easily added at the end of the table if necessary.

Acknowledgements

Thanks to Dr. Glyn Harding for his helpful suggestions on program structure, and to Irv Hoff for his suggestions pertaining to the lookup table. ■

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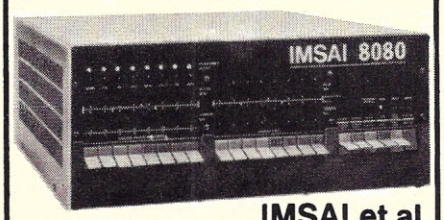

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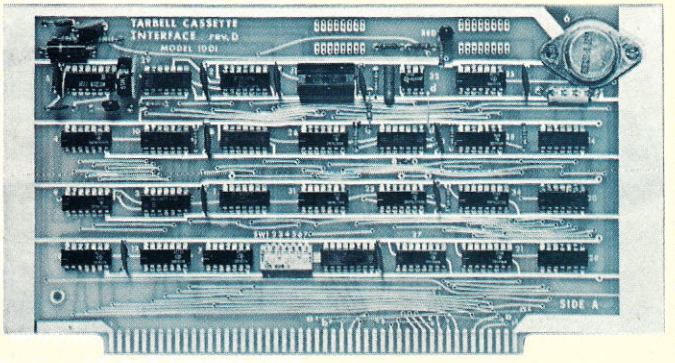

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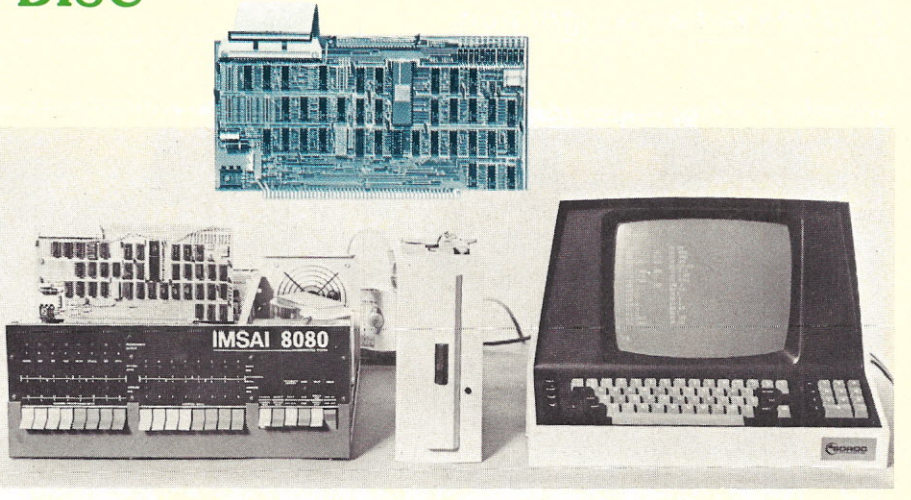

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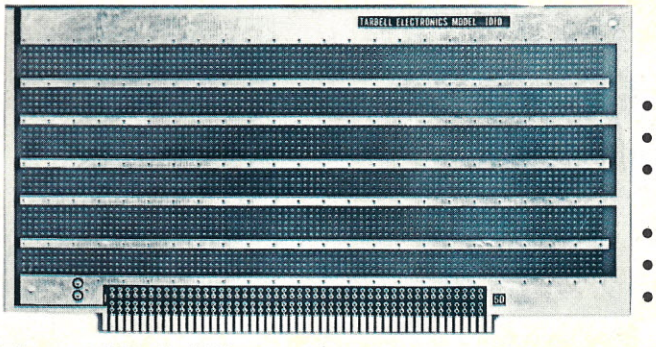

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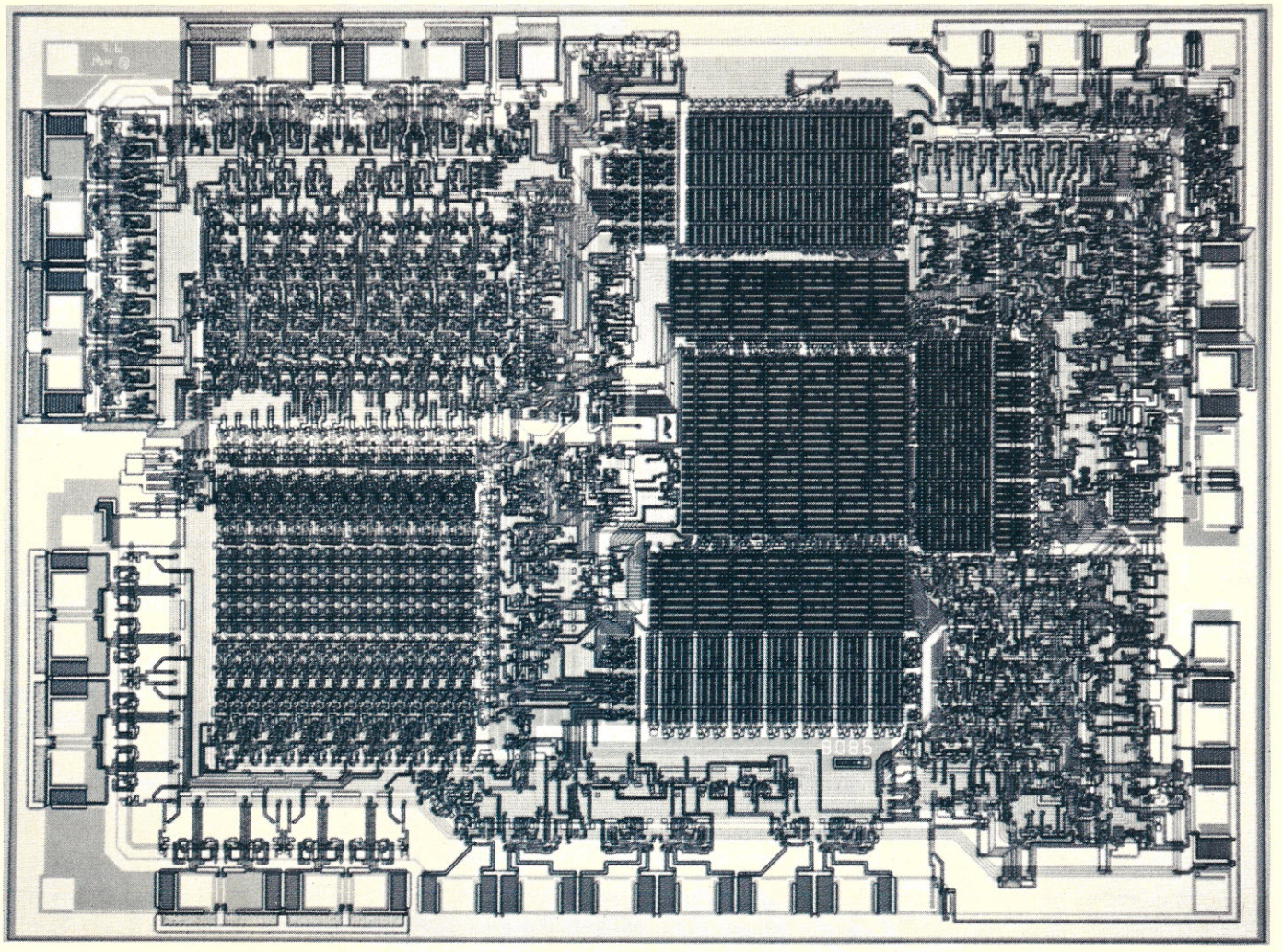
I like objective reviews of products. Michael Slater is a development engineer with Hewlett-Packard in Santa Clara CA (i.e., he isn't associated with Intel). He makes extensive use of Intel microprocessors in his work . . . and has some worthwhile comments and comparisons on their new 8085. See if you agree.—John.

8080, Z-80 or 8085?

A look into the relative merits of three Intel chips—you may find that you're happy right now.

The 8085 is Intel's latest entry into the eight-bit microprocessor market. As an enhanced version of the 8080, the 8085 forms the basis of a microcomputer system that is both simpler and more powerful than the 8080. The introduction of the 8085 has made the 8080 obsolete and provided



Photomicrograph of the 8085.

some strong competition for Zilog's Z-80.

Some History

Intel's 8080 microprocessor made the first hobbyist computer possible, and has since become the standard of the industry. Though numerous other processors have taken over a significant share of the market, there is still more hardware and software available for the 8080 than any other processor. In order to make it easier for people now using the 8080 to switch to a next-generation processor, Intel and Zilog have both introduced new processors that can use, without modification, most programs written for the 8080.

Zilog's Z-80 was the first processor to threaten the 8080's market dominance by including the entire 8080 instruction set as a subset of its own, much larger, instruction set. Therefore, most programs written for the 8080 will also run on the Z-80. In addition, the Z-80's sophisticated instruction set makes it attractive for software-intensive applications. Zilog also improved the 8080 hardware by providing on-chip clock generation, single supply operation, a faster clock rate and other features.

Now Intel has introduced a new processor, the 8085, which is also software compatible with the 8080. Intel has taken a different approach than Zilog, however, by making only negligible additions to the instruction set and placing emphasis on a simplified hardware system. Intel's goal was to simplify the entire system, including ROM and RAM.

With the 8085 system, it is possible, using only three ICs, to build a system with 256 bytes of RAM, 2K bytes of EPROM or ROM, 39 bits of I/O, a programmable timer and four vectored priority interrupts. No other microprocessor can provide this much capability with only three chips.

The 8085 System

The three ICs that make this powerful system possible are the 8085 processor, the 8155 RAM, timer and I/O, and the 8755 PROM and I/O. Fig. 1 shows the complete minimal system. All three ICs are contained in 40-pin packages, which allows the integration of other functions with the ROM and RAM chips. The system has two unique features: a multiplexed address/data bus and two special chips that provide RAM, ROM, I/O and a timer.

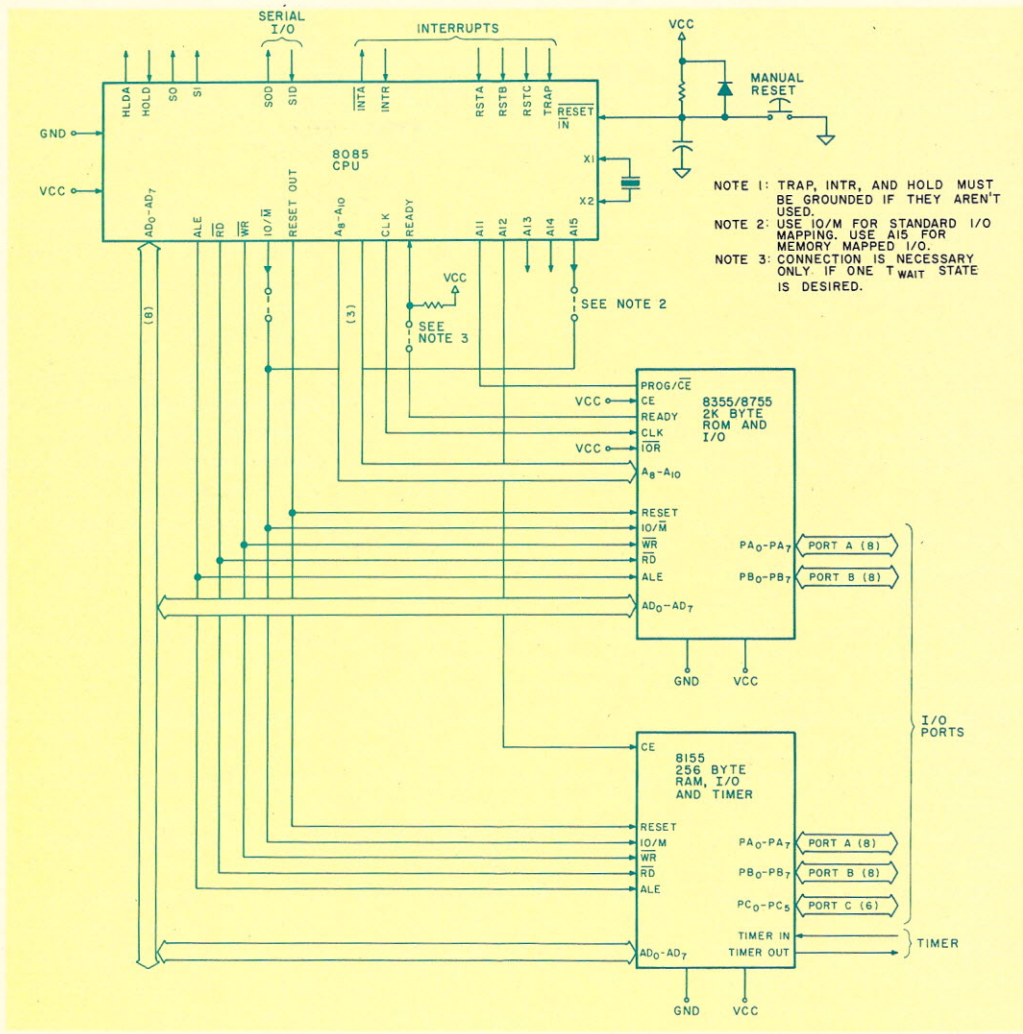


Fig. 1. 8085 minimum system. The three-chip system consists of the 8085 processor, the 8755 EPROM and I/O and the 8155 RAM, I/O and timer. The system bus is similar to the 8080 except that the low-order byte of address and the data bus are multiplexed together.

Fig. 2 summarizes the main differences between the 8080, the 8085 and the Z-80. The 8085 does not require a clock generator or system controller chip, as does the 8080. It provides three vectored interrupts without any external hardware. Other features include a single 5 V supply, serial I/O pins and a 3 MHz clock speed.

The 8085 CPU

The major architectural change in the 8085 is the use of a multiplexed address/data bus. The data and the lower half

	8080	8085	Z-80
On-chip clock generator	no	yes	yes*
On-chip status latch	no	yes	yes
Vectored, priority interrupts without external hardware	no	yes;three	no
Nonmaskable interrupt	no	yes	yes
Single 5 V supply	no	yes	yes
Serial Input/Output on-chip	no	yes	no
Clock speed	2 MHz	3 MHz	2.5 MHz
Special multifunction support chips	no	yes	no
Multiplexed bus	no	yes	no
Expanded instruction set	—	no	yes
Dynamic memory refresh	no	no	yes

*Oscillator required

Fig. 2. Comparison of the 8080, 8085 and Z-80.

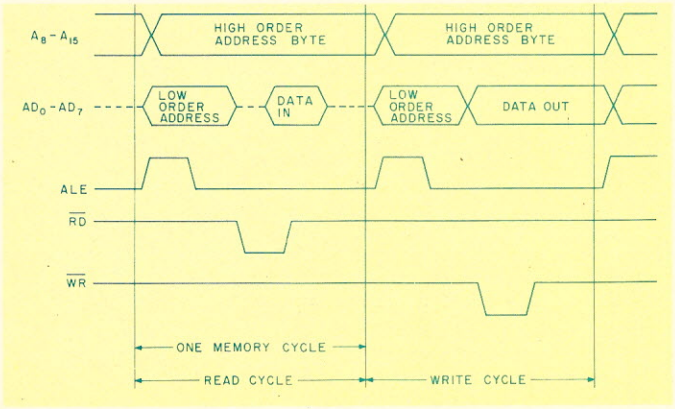


Fig. 3. 8085 system timing. The trailing edge of ALE signals the rest of the system that the address/data bus contains a new address.

of the address bus are multiplexed onto a single set of eight pins. At the beginning of each memory cycle, the low-order byte of address is placed on the address/data pins and a new control signal, Address Latch Enable (ALE), is generated to indicate that a new address is present on the address/data lines. ALE clocks this byte of address into a latch external to the processor. This latched address is then fed to the rest of the system, and the processor can free the address/data lines to carry data. The bus timing is shown in Fig. 3.

This multiplexed bus reduces by eight the number of address and data bus lines required. Only one new signal (ALE) is added to accomplish this, so the 8085 has seven more pins available for control signals. Two additional pins were freed by the elimination of the +12 V and −5 V supplies. These nine free pins make possible many of the 8085's new features.

The 8085 has four new interrupts that give it a simple and powerful interrupt structure—three priority interrupts, and one unmaskable (top priority) interrupt. Each is controlled directly by a single pin on the 8085; no other hardware is required to make the interrupts priority or mask them, or to insert an instruction on the data bus, as is required with the 8080.

The pins are called TRAP (nonmaskable) and RST 5.5, RST 6.5 and RST 7.5. Fig. 4 shows the 8085's interrupts and their jump addresses. A high level on the RST 5.5 pin, for example, will cause a jump to address 002C, provided that interrupt has been enabled.

In order to allow these interrupts to be individually masked, two new instructions were added. Set Interrupt Mask (SIM) selectively disables the interrupts. Read Interrupt Mask (RIM) allows you to read the status of the interrupts. These two instructions are the only additions to the 8080 instruction set.

The 8085 has pins for serial I/O to provide one input bit and one output bit without any peripheral hardware. The RIM and SIM instructions are also used to read and set the serial I/O pins.

The 8085 provides all of the control signals directly at its pins. With the 8080, an 8228 is required to latch the control signals off the data bus, on which they were multiplexed.

The 8085 control bus is also organized differently. The main control signals are $\overline{RD}$, $\overline{WR}$ and IO/$\overline{M}$. IO/$\overline{M}$ indicates whether the instruction is addressing an I/O port or memory. This saves one control line as compared to $\overline{MEMRD}$, $\overline{MEMWR}$, $\overline{IORD}$ and $\overline{IOWR}$ in the 8080. Both sets of signals contain the same information, and one can be generated from the other using a few gates.

The 8085 has pins for Reset In, Reset Out, Ready, HOLD, HLDA, INTR and $\overline{INTA}$, which function identically to those on the 8080. There are two new status lines (S1 and S0), which indicate whether the current cycle is an op-code fetch, a read or a write, or if the processor has been halted by a HALT instruction. The read and write status information is not used to control bus transfers, but provides advanced timing information on the type of machine cycle in progress. In most systems this information is not used.

The 8085's final hardware simplification is the addition of a complete clock generator on the CPU chip. The only required clock components are a crystal or a resistor and capacitor. This incorporates the functions of the 8224 within the 8085, and completes the transition from the three-chip CPU of the 8080 to the 8085, a true one-chip CPU.

Processor Speed

As an additional performance improvement, the 8085's instruction execution rate is about 50 percent greater than the 8080's. The basic clock frequency is 3 MHz, as opposed to the 8080's 2 MHz. (The recently released 8085A-2 runs at *5 MHz*!) In addition, there is a subtle increase in speed by clever handling of conditional jumps. The 8085 fetches the second byte of the instruction (the first byte of the jump address) while it is deciding if the jump condition is satisfied, and then skips the last byte of the instruction (the second byte of the address) if it doesn't need to make the jump. The 8080 always fetches all three bytes and wastes a machine cycle if the jump condition is not satisfied. Thus, the 8085 executes an unsatisfied conditional jump in approximately 30 percent fewer clock cycles than the 8080.

There are two new versions of the 8085 now available. The 8085 is being replaced by the 8085A, which is identical in most respects. The new A version differs only in the state of certain control signals during specific conditions, which are

Interrupt	Jump Address (HEX)
RST 0	0000
RST 1	0008
RST 2	0010
RST 3	0018
RST 4	0020
*TRAP	0024
RST 5	0028
*RST 5.5	002C
RST 6	0030
*RST 6.5	0034
RST 7	0038
*RST 7.5	003C

*Fig. 4. 8085 interrupts. The interrupts marked with * are new to the 8085, and each has its own interrupt request pin. The others are the same as the 8080 interrupts and are initiated using INTR and $\overline{INTA}$.*

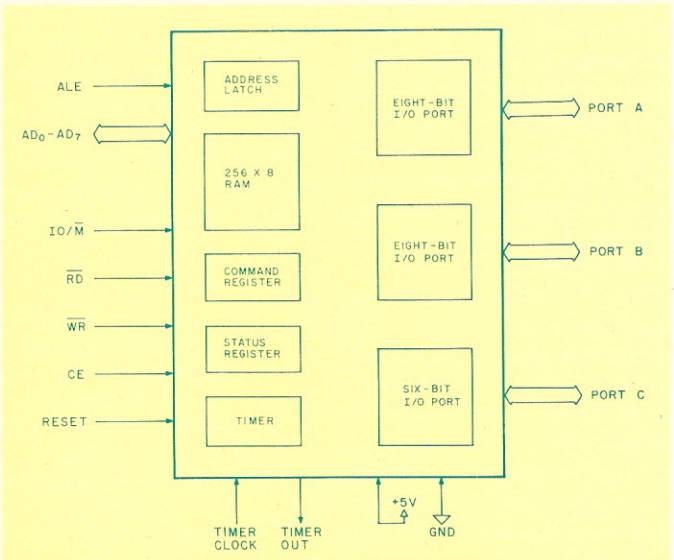


Fig. 5. 8155 RAM, timer and I/O. Each of the three ports may be selected as input or output. Additionally, port C may be selected as a control/status port. The selection of port modes, as well as the control of the timer, is performed by writing the appropriate control word to the command register.

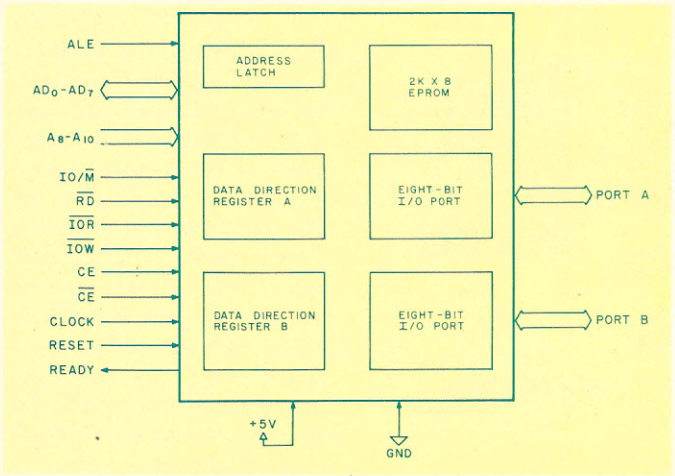


Fig. 6. 8755 EPROM and I/O. Each bit of the I/O ports may be individually selected as input or output via the two data direction registers. The 8355 is an identical part except that it contains a mask-programmed ROM.

"don't cares" for most users. The changes will make the 8085A easier to use in some large systems. The new 8085A-2 is the fastest general-purpose, eight-bit processor now available.

The 8085 Memory and Interface Chips

As shown in the previous section, the 8085 added many hardware features at the price of the added complexity of a multiplexed address/data bus. The penalty is not too high, however, since the bus can be de-multiplexed with a single eight-bit latch. And, in fact, Intel has turned the multiplexed bus into a valuable feature by providing memory and peripheral chips with the address de-multiplexing latch on the chip. Thus, the chips have only eight address/data pins and an ALE pin, instead of eight data and eight address pins. This saves seven pins on each chip, as well as seven bus lines.

The 8155 chip contains a 256-byte static RAM, two eight-bit I/O ports, a six-bit I/O port and a 14-bit programmable counter/timer. The block diagram is shown in Fig. 5. A command register in the 8155 determines the function of the ports and controls the timer. The two eight-bit I/O ports may each be specified as input or output ports. The six-bit port may operate as an input, output or control port. In the control-port mode, it provides a strobe input for either of the eight-bit ports to be used as latched input ports. It also provides a buffer full signal for each of the ports, indicating that the port contains new data that has not yet been read.

The 8155 also contains a 14-bit programmable timer. It has several modes of operation, but, basically, it will count a specified number of clock pulses and then generate an output pulse. The clock may be the system clock or any other signal. Both the mode and the number of counts are under software control via a command register, and the timer's status may be read from a status register on the chip.

The third chip in the system is the 8755, which contains a 2K X 8 EPROM and two eight-bit I/O ports. The block diagram appears in Fig. 6. The EPROM is similar to a 2716; the two I/O ports are unique in that each line may be individually specified as input or output. Thus, you may have five input bits and eleven output bits, for example. The mode of each pin is set by software, via two data direction registers on the chip.

The 8355 is identical to the 8755, except that it contains a mask-programmed ROM. For applications where the same program is to be reproduced in considerable volume, the 8355 provides a cost-effective alternative to the 8755.

Applying the 8085

The 8085 is a very easy microprocessor to use. Using the basic three-chip system already discussed, the only additional components required to make a complete microcomputer system are a crystal and power-up reset circuitry. Peripherals are, of course, required, but they are independent of the particular processor being used.

Standard memory and peripheral chips may also be used with the 8085, but the address/data bus must be de-multiplexed. Fig. 7 shows the address latch to perform this function, in addition to the gating to generate 8080-type control signals. ALE strobes the address into the latch (see timing diagram in Fig. 4). The latched outputs drive the lower half of the address bus. The data bus actually contains address information early in each memory cycle. This doesn't cause any problems because neither $\overline{RD}$ nor $\overline{WR}$ will be true at this time, and all parts of the system should be ignoring the data bus. Once the bus has been de-multiplexed, any of the 8080 family components may be easily interfaced.

The control signal gating shown is straightforward. In practice, it will usually not be necessary to use actual gates. If the memory chips have more than one chip enable input (many do), one can be used for IO/$\overline{M}$ and another for $\overline{RD}$ or $\overline{WR}$ (for RAMs) or just $\overline{RD}$ (for ROMs). When the 8155, 8355 or 8755 are used, no gating of any kind is needed; it is incorporated into the memory chip.

An interesting side note is that the signals have been arranged on the pins of the three chips to facilitate simple and dense PC layouts. A complete system consisting of the three chips, crystal, pull-up resistor for the Ready line, and resistor, capacitor, and diode for power-up reset, fits on a circuit board measuring 3 1/4 x 4 5/8 inches. The layout for this board is provided in Intel's *8085 Microcomputer Systems User's Manual.*

Current Products

There are currently at least two 8085-based products suitable for personal-computing applications. Intel produces the SDK-85, which is a single-board computer complete with keyboard (hexadecimal and control) and a six-digit display. An 8355 ROM chip contains a monitor program to allow entering of programs, viewing the contents of memory and numerous other features. An 8155 provides 256 bytes of RAM. All of the I/O lines are available, and a large wire-wrap area is provided for expansion. A complete kit (less power supply) is available from any of Intel's dis-

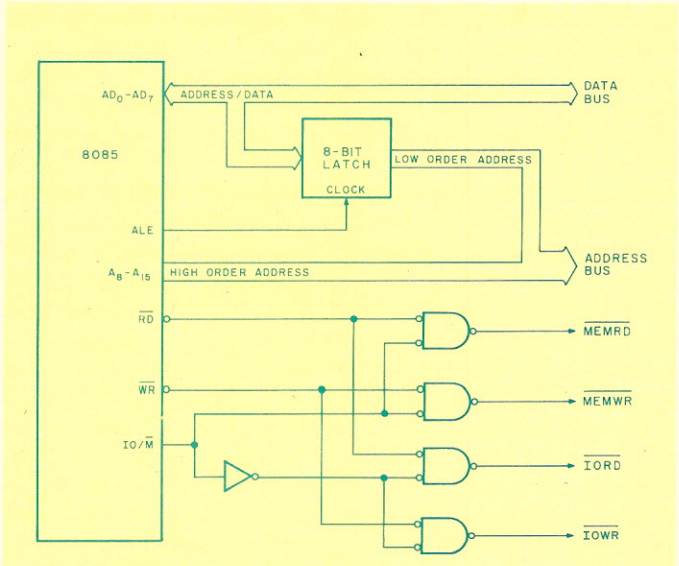
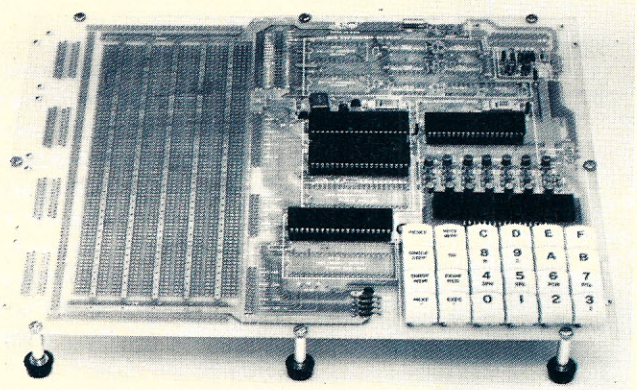


Fig. 7. Interfacing the 8085 to an 8080-type bus. The latch de-multiplexes the address/data bus, and the gates generate the usual bus control signals.

tributors for 250 dollars.

The other product is the SPACE BYTE 8085 CPU. It is an S-100-compatible CPU board utilizing the 8085 and 8155, with three 2708s, instead of the 8755. The PROMs contain a system monitor. Two RS-232C serial ports, along with parallel I/O, are provided. The bus is demultiplexed, and S-100-compatible control signals are generated. It is available from the Space Byte Corporation (and computer stores) for $499.



Intel's SDK-85 design kit.

The 8085 vs the Z-80

Since the Z-80 and the 8085 are the only 8080-compatible processors now available, many users will be faced with the task of selecting one of the two. One thing is clear: There is no longer any reason to design a system using an 8080.

From a software viewpoint, the Z-80 is superior. It has a greatly expanded instruction set, and double the number of registers. There is some question, however, as to the value of this increased software power.

If you program in BASIC or other high-level languages, the Z-80's extra instructions will make no difference to you. If you have an interpreter optimized for the Z-80, your BASIC might run faster than on an 8085. The difference is likely to be insignificant to most users.

One of the Z-80's features is special instructions for block move and block search. These instructions are useful when blocks of data are being processed. It must not be assumed, however, that these instructions speed up block-oriented tasks. In fact, block-move and block-search subroutines for the 8085 may run faster than the single instructions on the Z-80! The 4 MHz Z-80A is faster than the 8085 subroutines, but the difference is not likely to be significant. You would have to write and store these subroutines, however, and that is the advantage of the Z-80's built-in instructions.

In the realm of hardware, both processors have their advantages. The 8085's new interrupts are much easier to use than any of those available on the Z-80. The scheme is less flexible than the Z-80's, but is more than adequate for the vast majority of applications and requires no external hardware. For those few applications that really do require a sophisticated interrupt structure, Intel's 8259 interrupt controller chip provides this capability. Another ease-of-use factor is the 8085's on-chip oscillator. The Z-80 requires an external clock oscillator, while the 8085 requires only a crystal.

A big advantage of the 8085 is the available support chips. A much simpler and more powerful minimal system is possible with the 8155 and 8755, as compared with the Z-80 system. Because of the multiplexed address/data bus, it would not be easy to use these chips with the Z-80 (or any other processor).

The power of the 8085 system is most apparent in dedicated controller systems, where 256 bytes of RAM and 2K bytes of ROM are adequate. The 39 I/O lines provided by the three-chip system are enough for most applications. For applications requiring more memory, only one chip (an eight-bit latch such as the 8212) is required to interface to standard memories. The inclusion of the 8155, though contributing a relatively small amount of RAM, provides a counter/timer and 22 flexible I/O lines with some associated control logic.

The Z-80 also has its advantages, but they are relatively minor. It does not multiplex any pins, which saves one chip when interfacing to standard memories. This is offset, however, by the lack of an on-chip clock oscillator.

A much-acclaimed Z-80 feature is the dynamic memory refresh incorporated into the CPU. It is not, however, without its problems. The refresh address is output during each op-code fetch cycle. Therefore, the refresh rate is directly tied to the instruction execution rate, which may have serious consequences. If the processor is single-stepped, either by slowing the clock or by using the Ready line, the refresh will no longer work. Reset will also halt the refresh, so if a manual reset push button is incorporated in the system, some form of one-shot must be used to protect the memory from being wiped out by the reset button. Finally, a lengthy DMA operation may precipitate loss of the memory contents.

A couple of other points about refresh are worth mentioning. The vast majority of systems use either static memories (where refresh is not needed) or dynamic memory cards with built-in refresh circuitry. Another consideration is that the Z-80 will usually refresh the memory at a much faster rate than necessary, resulting in a higher power consumption for the memory.

The choice of an 8085 or a Z-80 ultimately must depend upon the application. In a dedicated controller type of application where the 8085 three-chip system provides adequate resources, the 8085 is definitely the best choice. In a software-intensive application where much assembly-language programming is anticipated, the Z-80 would probably be a better choice. For the myriad of applications that fall between these two extremes, the advantages and disadvantages of each processor must be carefully weighed. If the decision seems difficult, perhaps you can take comfort that either processor would probably do the job well.

Future Products

As may be expected, the battle between Intel and Zilog will not stop here. As Zilog is planning the Z-8 and Z-8000, Intel is working on the 8086 and 8088. The 8086 will be a high-speed (8 MHz clock) 16-bit processor to be introduced early in 1978. It has been reported that the 8088, to be released some time later, will be a 16-bit processor internally, but will use an eight-bit external data bus. Eventually, the 8088 may replace the 8085 in many applications. These next-generation processors will retain basic software compatibility with the 8085 (via assembly-language translation programs) and will also have a similar bus structure.

The 8085 may never have the popularity enjoyed by its predecessor, but its impact on the market will definitely be felt. It is especially cost effective in dedicated controller applications, but it is worth close examination by anyone designing a new system.■

References

1. *8085 Microcomputer Systems User's Manual*, Intel Corporation, Publication no. 98-366B, $5.

2. *8080/8085 Assembly-Language Programming Manual*, Intel Corporation, Publication no. 9800301B, $5.

3. *An Introduction to Microcomputers*, Osborne and Associates, Vol. II, 2nd edition.

Intel publications are available from: The Intel Corporation, 3065 Bowers Ave., Santa Clara CA 95051.

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Inserting this simple two-chip circuit between the ASCII keyboard and the input port solved the problem. The circuit takes ASCII data from the keyboard and converts the characters 0-9, A-F to their proper four-bit hex format. Now my one ASCII keyboard can function either as an ASCII or hex keyboard, depending on system requirements.■

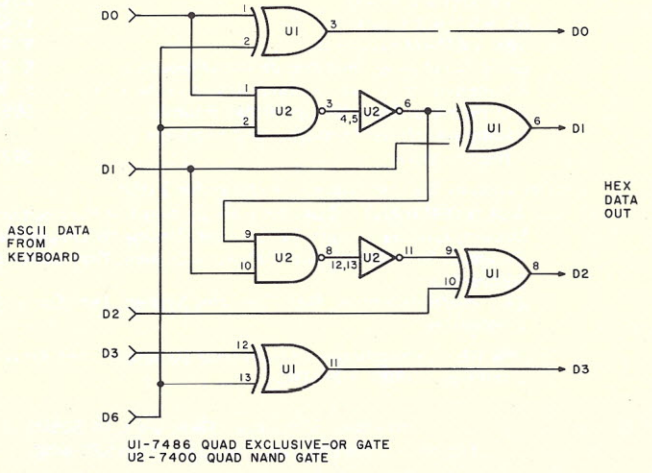

Fig.1. ASCII-to-hex data converter.

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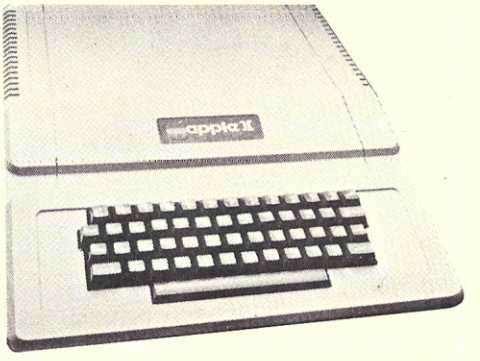

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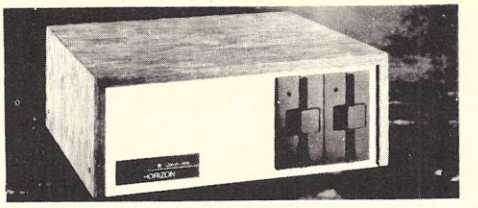

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Is the Malibu Model 160 the Printer for Your Business System?

At $200, this may not be a popular hobby printer, but for business, where a 132-column printer is a must, it's most interesting.

One of the most important pieces of peripheral equipment for any business system is the printer. During my search for a suitable printer for my system, I was confronted with trade-offs and considerations, but two items remained at the top of the list—dependable operation and speed. I feel that I've obtained both through the purchase of a Malibu printer and would like to share with you some of the fine points, and a few shortcomings, of the unit.

I am neither a technician nor an engineer; I am a businessman. Even though I had some technical assistance in the preparation of this article, the bulk of the comments here reflect my feelings on how the unit contributes toward making my system the useful tool it is. John Craig suggested that I direct my remarks to other businessmen who might also be shopping for a hard-copy device.

General Overview

As mentioned earlier, dependable operation and speed were two of the main considerations, but the added bonuses of quiet operation and styling were also realized with the Malibu unit. Photo 1 shows the styling, which, quite frankly, played a part in my decision (moving that teak cabinet into my office was almost like adding a fine piece of furniture). The clear plastic cover over the print mechanism, which almost completely seals the entire unit, contributes greatly toward noise reduction. There is, of course, a slot for the paper to come out of the top and enter from the bottom, but the noise escaping from these two openings is minimal and not objectionable. I am sure the soundproofing within the cabinet contributes a lot toward this end.

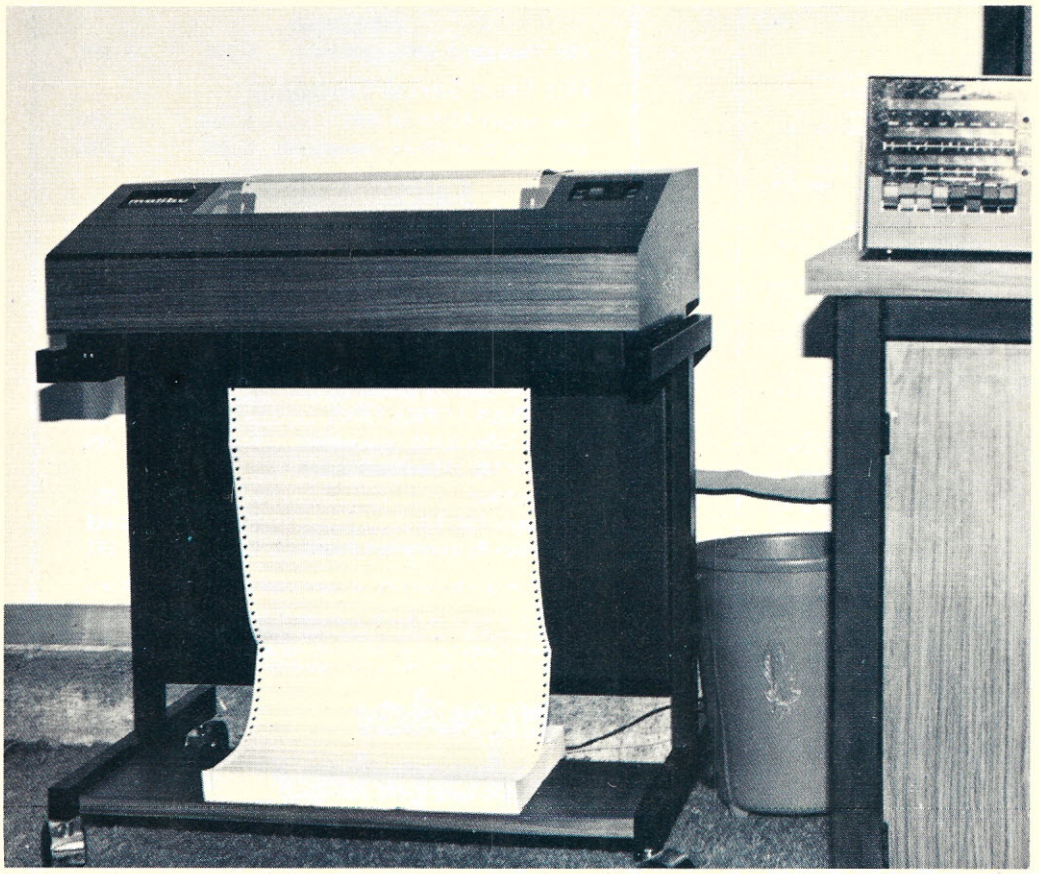

Photo 1. The Malibu Design Group Model 160 Printer: a good-looking unit.

I've been using my disk-based Imsai system for almost a year now and there have been several instances when I've had to go through the trauma of adding (interfacing) additional devices that hardly ever worked—at first, anyway—even though the additions were installed by experienced technicians from the store where I bought my system. Adding the hardware components of this printer to my system went smoothly. The entire operation took no more than 15 minutes and simply involved removing the cover from the computer, plugging in the S-100 interface board, running a cable over to the printer, plugging it in and turning everything on! (More on the software interface later.)

Prior to the Malibu printer, I had been operating with an ASR-33 Teletype. The difference in speed, print quality and noise level between the two is so vast that I'm only mentioning the Teletype as an after-

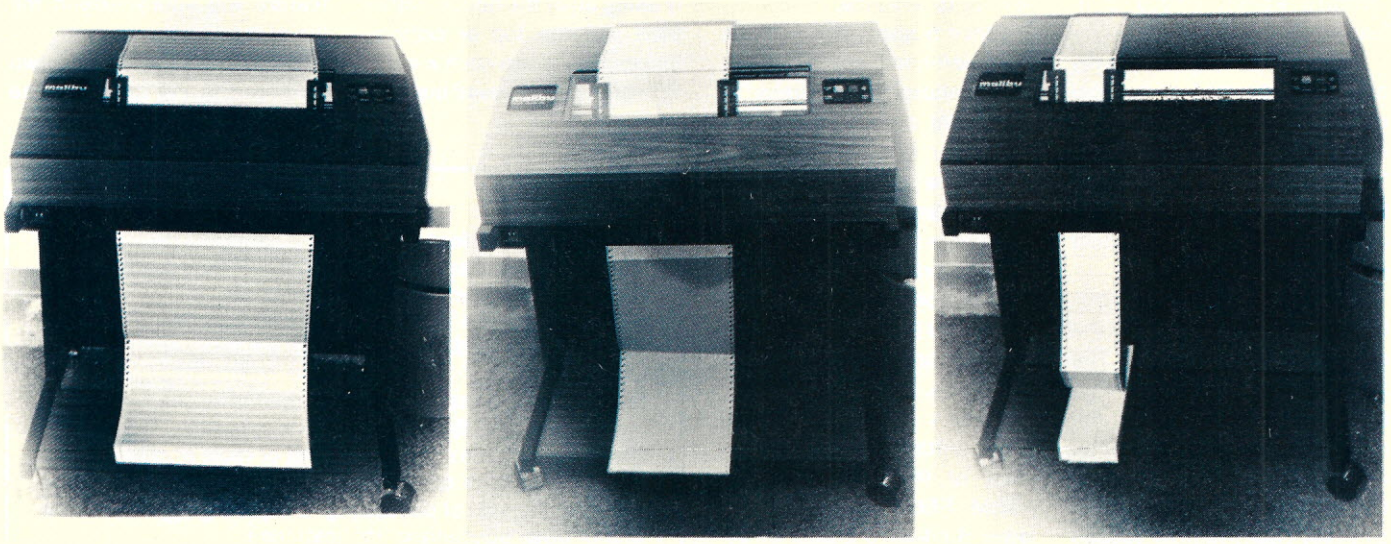

Photo 2. Different-sized paper and forms. A big plus for the Malibu.

thought. Comparing the dependability of the two is difficult at this time since I've only been operating the Malibu for a few weeks. Due to the small number of moving parts, I'm confident the Malibu will come out shining in this area.

Printing is done at an incredible 165 characters per second! (Memories of the Teletype surely fan my enthusiasm on this point.) Much of the speed results from the unique combination of hardware and software which allows printing in both directions and determines the shortest distance the printhead has to go to begin printing. This feature is called bidirectional printing.

For example, if a line of 120 characters has just finished printing, and the next line to be printed is 80 characters long, a line feed will be initiated and the 80-character line will be printed backwards—while the printhead returns to the leftmost (home) position. In many other printers a line feed *and head return* will take place before the second line is printed—resulting in a lot of wasted time.

The print quality and character set were two important considerations in my choice of the Malibu. Several of the printers I looked over during the shopping stage produced very light printouts in comparison. One of the reasons the Malibu provides such dark, high-contrast printing is due to the self-inking ribbon used. Another factor is the Hydra printhead (more on that later).

One of the features I disliked most on other printers I looked at was the absence of descenders (the "tails" of certain lowercase letters actually *descending*). The Malibu character set provides for these descenders —as all the others should. Fig. 1 is a sample printout.

I'm not particularly thrilled that the unit is a dot matrix, rather than impact printer, but my wallet is happier that I didn't go with the latter.

I've asked several of my customers what they think of the new invoices they have been getting. Generally, the response is that, though they prefer not to get invoices at all, the new ones are quite an improvement over the old (generated by the Teletype). When I press them for an opinion on the actual characters—and how they are generated (with dots)—the usual response is, "Gosh, I hadn't noticed." So much for the shortcomings of dot-matrix print.

Miscellaneous Considerations

I dislike reading equipment reports that contain numerous dry specifications. But there are several features of this printer that really should be mentioned.

The maximum line length is 132 characters, one of the considerations that made me decide on the printer. Several low-cost printers provide 72-character width, but I find that some monthly and quarterly reports practically demand the wider paper. Invoices are prepared on 8½- × 11-inch paper, and the mailing labels I generate for customer mailings are approximately 4½ inches wide. The variable width tractors are a

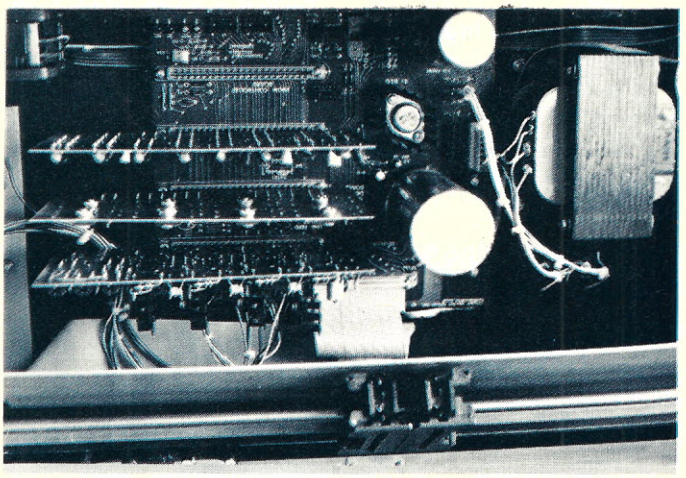

Photo 3. Inside the Malibu, the three main printed-circuit boards.

```
 ,/0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-.
 /0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./
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abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&' ()*+,-. /01
BCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqr
```

Fig. 1. Sample printout showing normal and expanded characters. Also note the lowercase characters with descenders.

definite asset. Photo 2 illustrates this capability.

Although I intend to have my computer serviced at a local store, it seems that I could almost make the repairs myself. That is, if I weren't afraid to take the cover off the unit and dig inside, and if I had spare printed-circuit boards.

There are only three boards in the printer to control all the operations (see Photo 3). The first is the logic card that interfaces with the software. (Incidentally, all of the character generation is done in software; therefore, the character set can be easily changed.) The second board controls the motor that feeds the paper and also controls the movement of the printhead. (Software makes the decisions regarding the direction it should take for the fastest print time.) The third board drives the solenoids on the printhead.

There is a fourth interface board, which contains a Z-80 microprocessor. This board is used for connecting the printer to systems other than the S-100 type and provides for two types of interfacing—RS-232 or 8-bit parallel (at speeds from 110 to 9600 baud). My Imsai, quite naturally, uses the S-100 interface board. This board contains the programs, in programmable read-only memory (PROM), for generating the particular characters, handling the line of characters and telling the paper-feed motor when and how far to advance.

A thumb-wheel switch in the lower left-hand corner of the printer allows the operator to select the number of spaces the paper will be advanced every time there is a FORM FEED command. This is a command from the computer which tells the printer to advance to the next form (e.g., the next invoice to be printed). The switch provides for settings from 1 line to 99 lines.

Photo 4 shows the manual paper-control switches on the cover of the unit. When the FORM FEED switch in the lower right-hand corner is depressed, the paper is advanced to the next page (the number of spaces is determined by the thumb-wheel switches).

Using this feature, the paper can be positioned to a spot called "top-of-form" so that printing will begin in the same position for each page. The LINE FEED switch will cause the paper to be advanced one space for each depression. The other two switches provide for incremental up or down positioning of the paper. No big knobs to turn—just push a button.

There is a particular feature about the ribbon which, although it is small, reflects the thoughtfulness that went into the overall design of this printer. The ribbon is set up to traverse from one side to the other *at an angle*. The result is that the printhead is continually using all of the ribbon, rather than just the top or bottom. Since ribbons are such a mess to change, I'm relieved that this feature will surely extend the life of the ribbon.

The Hydra printhead, shown in Photo 5, is, I've been told, one

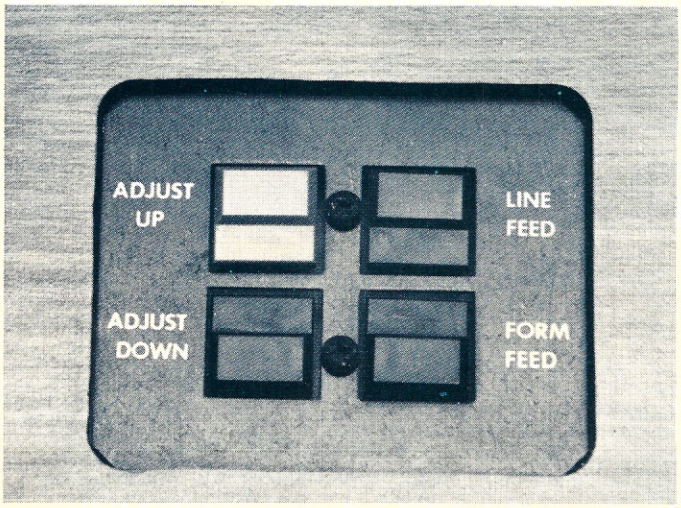

Photo 4. The manual paper-control switches.

Glossary

8-bit parallel interface: Transferring data from the computer to a device one character at a time, rather than sending each bit of the character at a slower serial rate.
Bidirectional: The ability of a printer to print characters while the printhead is traveling from left to right or from right to left.
Baud: A data transmission term related to the number of bits (BInary digiTS) transmitted in a second.
Character set: The complement, list or table of characters a printer is capable of printing. (With a different PROM the Malibu is capable of generating foreign-language character sets or other specialized applications.)
Descenders: The "tail" on certain letters, such as the j, y, p, g and q.
Dot matrix: The generation of characters by a matrix of dots. Following is an example of how a capital A is generated using a 5 × 7 matrix:

```
 x
 x x
x   x
xxxxx
x   x
x   x
x   x
```

Each x represents a dot made by the printhead. Due to the close spacing of the dots, the letters seem to run together into continuous lines.
Head return: The action of the printhead being returned to the home position (i.e., at the extreme left, where each new line begins). The same as a carriage return on a typewriter.
Impact printer: A printer that prints characters in the same manner as a typewriter.
Interface: The interconnecting of two devices (e.g., the computer and the printer) so they can work together as part of a system.
Line feed: The action of advancing the paper to the next line to be printed.
Line length: The number of characters that can be printed on a line (132 with the Malibu).
Patching: Modifying the software with minor changes so that the operation of a particular device becomes an integral part of the system.
Printhead: An assembly containing seven solenoids activated by electrical impulses to produce the dots that generate the printer's characters.
PROM (programmable read-only memory): A memory element that cannot be modified and can only be read. (All of the mechanical movements and character generation functions are contained in PROM in the Malibu printer.)
Routines: Program segments that are not part of the main program.
RS-232: An interfacing standard between computers and other devices that dictates the voltage levels at which data may be transmitted.
S-100: The "standard 100" pin bus that originated with the Mits Altair 8800 computer and has found widespread use in most microcomputer systems today.
Thumb-wheel switch: A rotary-type switch providing for the selection of a digit from 0 to 9.
Tractors: The devices at each end of the paper that accept the perforated holes in the paper and use those holes for feeding the paper.

of the most reliable and rugged available. Time will be the real test of this component, which is the heart of the printer, but so far I've been impressed with the quality of print it delivers and its rugged constitution. Since the entire unit radiates quality, I have no reason to doubt the claims made about the printhead.

Software Modifications

When you add a device such as this to your system there are actually two types of interfacing to contend with—the hardware and the software.

Making the printer work with my existing software involved modifying the programs with patches so the printout would be on the Malibu, rather than my Teletype. An experienced programmer took care of these modifications in a three-to-four-hour period. He explained to me that the task could have been very difficult if I did not have well-designed software.

Basically, the modifications involved changing the programs (making patches) so when printing is desired, control is transferred to the routines in PROM (provided by Malibu) on the interface board that handle character generation, line handling and paper-feed functions.

Closing Thoughts

The primary use for this printer in my business (restaurant supply) is for generating monthly reports, customer billing, mailing labels and some accounts payable. It handles all of these jobs without a hitch. Because it is a dot matrix printer I'm not certain that it would be as satisfactory if my requirements included large quantities of textual material. However, I intend to try it with some customer bulletins in the future. For such applications, an uppercase and lowercase impact printer may be a better choice.

I don't normally sit down to write reports on products I have bought, but I was very impressed with this printer. I'm still fascinated with the speed of the unit and appreciate the quality of the print.

I enjoy the finer things in life; I drive a 27-year-old Cadillac, and the quality built into that car will very likely keep it on the road for another 27 years. I feel the same way about the quality built into the Malibu printer.■

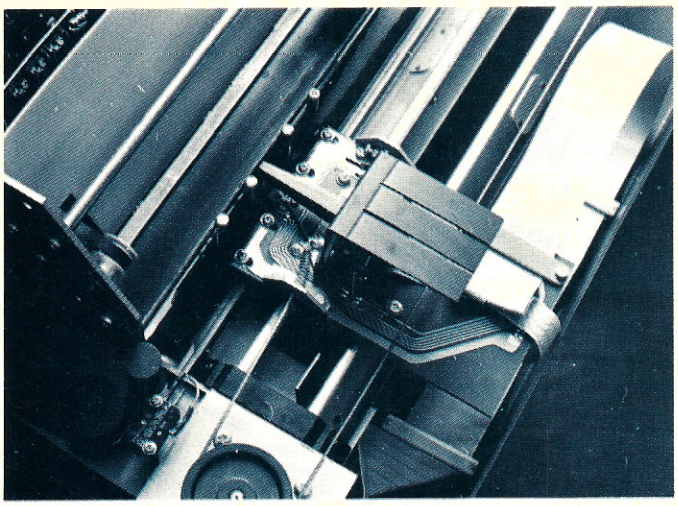

Photo 5. The heart of the printer: a high-reliability Hydra printhead.

The suggested list price for the Model 160 Line Printer is $1995 (which is very close to $2000). For further information, contact: Malibu Design Group, Inc., 21110 G Nordoff St., Chatsworth CA 91311, (213) 998-7694.

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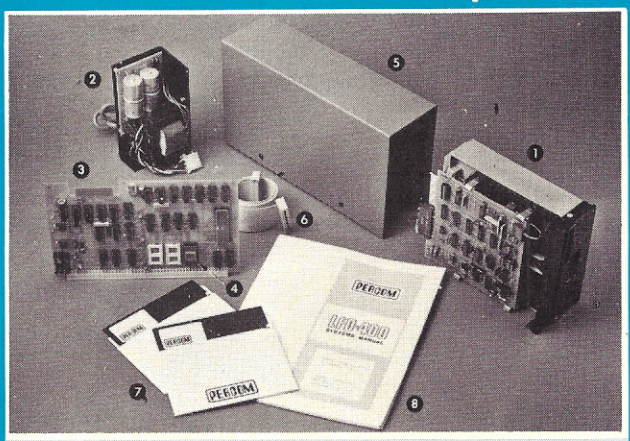

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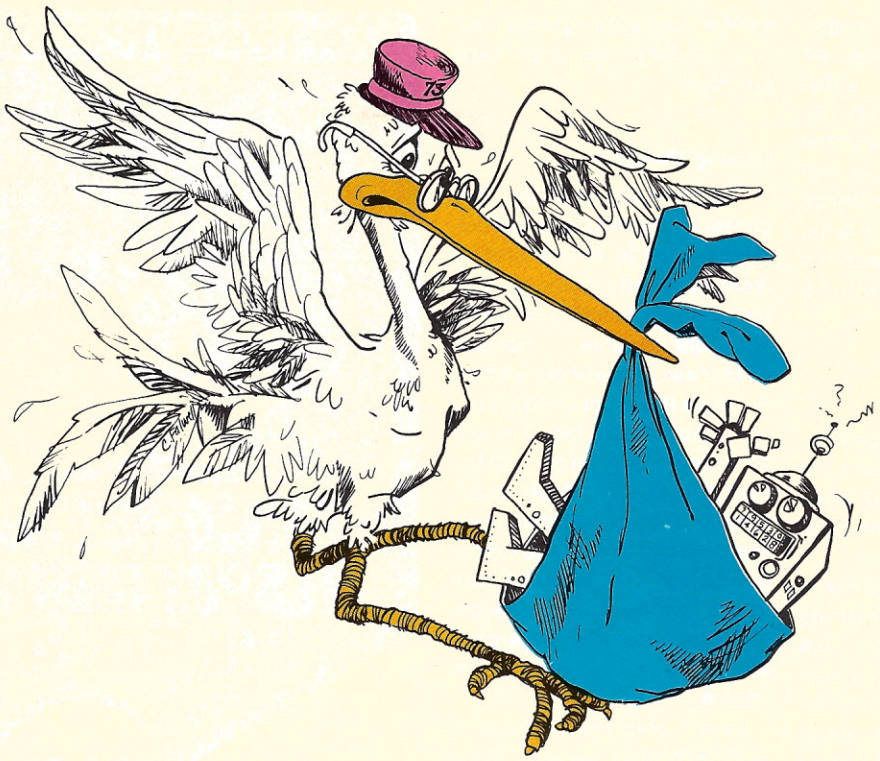

The Great Computer Conspiracy

You've heard that some people are afraid of computers? Maybe they have good reason to be.

Clint H. Woeltjen
La Habra CA

I guess it was bound to happen sooner or later with the office computer having access to billing as well as a telephone link to the lab computer, the new gigabyte memory and the new, unproven heuristic-algorithm operating system. We should have guessed that it was up to something when the auditor's computer started finding discrepancies in our records. No mere human could possibly have circumvented the system.

It began one day last March. The computer ordered several hundred more TTL ICs than we actually needed for the project at hand. We could find no programming error, so assumed human error or a temporary hardware malfunction and waited for it to show up again. Meanwhile, the extra ICs never made it to the lab. A mobile manipulator (we call them robots for want of a better term) had been sent to shipping and receiving to pick them up, but had returned empty handed. The plant is almost entirely automated, requiring only a few engineers and supervisory personnel.

The shipping-and-receiving administrator remembered seeing the package earlier, but didn't actually see the robot pick it up. Of course, you can't question one of our robots; they have only enough memory for the task at hand, so they can't be expected to remember previous jobs. Nor did we think of questioning the computer; after all, a computer only does what it's programmed to do (anyway, what would a computer possibly want with a bunch of ICs?). We deduced that it was employee theft, but no one would admit to having done it. We beefed up our security system (controlled by the office computer), which caused employees' morale to drop, which caused their efficiency to drop, which caused us to fall behind on several key contracts, which caused us to

become overloaded with work, which caused us to discontinue the security system.

A week later, we received a receipt for a megabyte memory that no one could remember ordering, or paying for. We checked our records and found the order, but it hadn't been initialed properly, so we couldn't tell who had ordered it. Of course, things like that aren't supposed to happen. The office computer is supposed to check for proper initials before printing the check and mailing the order. As we were overworked at the time, however, no one noticed the computer's error. This time, we ran a thorough diagnostic program, but were unable to find the bug. We didn't realize then how easy it was for a sophisticated computer to lie, its own program supplying all of the proper responses while the diagnostic rested harmlessly in memory. As happened before, the megabyte of memory disappeared.

Then the circuit-board inspector got in trouble for not asking the computer to order additional circuit-board material. He claimed that there had been two extra boxes of pre-cut boards just yesterday; so we programmed a more extensive security program, including video input of the entire lab area. This time, we didn't let the employees in on the upgraded security plan, and to make sure that no one might let it slip, I did all of the programming myself. As usual, the entire system was controlled completely by the office computer. We used the office computer rather than the lab computer because the men in the lab didn't have access to the office computer and couldn't change the program if they found out. Of course, we didn't know that the office computer and the lab computer were friends and exchanged programs whenever they felt like it.

The next day, a considerable amount of microcomputer hardware was missing, including a video terminal, several UARTs and some obsolete Z-80 microprocessors. We checked the videotapes but found nothing; the camera set up to record that part of the lab had been unplugged and the videotape erased. The night watchman claimed that he hadn't seen anyone enter or leave the building all night, but after all, he's only human and can't be in two places at once.

We were beginning to suspect that the stolen material hadn't left the building. We also noted that all that was needed to build a complete microcomputer out of the stolen material was a power supply. I instructed the lab computer to build such a supply, and left it out on the lab bench before leaving for the night. That afternoon, I also removed the cameras and deleted the security program. I had the lab administrator punch out for me, but I stayed behind in the lab. I hid within view of the bench containing the power supply and waited.

Shortly after the last employee checked out, I saw one of the robots roll across the floor, remove the power supply and head toward the lab storage area. Meanwhile, another robot had moved some boxes and was removing a metal wall plate that was normally hidden by the relocated equipment. In our earlier search we had noted the panel, but had assumed that it was an electrical maintenance panel and ignored it. I watched as the first robot arrived with the power supply, installed it and turned it on. In the recess was a microcomputer, complete with a video terminal (which indicates to me at least that the robot didn't intend to keep it a secret forever), and on the display was printed the mnemonic "DAD DE."

I didn't have the heart to turn it off. ■

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Personal Computer Shows

A visitor to the San Jose show suggests that organizers and exhibitors bring showmanship and general appeal to future computer shows.

Paul J. Terrell
BYTE, Inc.
1261 Birchwood Dr.
Sunnyvale CA 94086

We're growing up as an industry. That was the undertone of the recently held second annual West Coast Computer Faire. Having been an observer and participant for the past two years at computer faires, shows, swap meets, etc., I noticed that something was obviously different in San Jose. The throngs of people were there, and I judged from conversations with manufacturers that the sales level of products was just as brisk, but something was different. But what?

Electricity . . . it was in the walls, feeding the computer displays, but it wasn't in the air. The excitement and anticipation of new products from major manufacturers was missing. Radio Shack, Heathkit, and Commodore had long since made their debut. IBM displayed the 1510 computer, but at $18,000, no one was beating a path to their door.

Electricity is also generated by clever new inventions, but they were in short supply at the Faire. Lots of "me too" products were on display . . . whatever happened to our creativity? Dynabyte put robots on display and dilithium Press released its new publication, *Robots on Our Doorstep*, but both only hinted at what's to come. That leads me to the real message in this article: the maturation of our market.

If our industry trade shows are intended for the insiders—the retailers, computer jocks and technically elite—to share innovations in product design and make purchases for the next quarter- or half-year sales, then we owe it to the general public not to invite them.

Paul J. Terrell

If our shows are intended for the general public to increase their awareness of personal computing, then we owe it to our industry to give some thought to the educational aspects of the displays we exhibit and, in general, to the whole theme of the show.

Electricity was taken out of the air by a confused and bewildered public audience that couldn't get close enough to the displays they would have enjoyed if they had been told what they were seeing. It's a bit confusing to pass from the IBM booth with $18,000 computers to the Jade booth with $2 connectors and try to understand the relationship.

At the San Francisco Boat Show a person can spend $3 for an afternoon of entertainment and education in one of America's favorite pastimes. Isn't that what we want of our industry?

At the Consumer Electronics Show the public isn't invited and the guests are grouped according to their buying power by brightly colored badges that distinguish the tire kickers from the chain-store buyers.

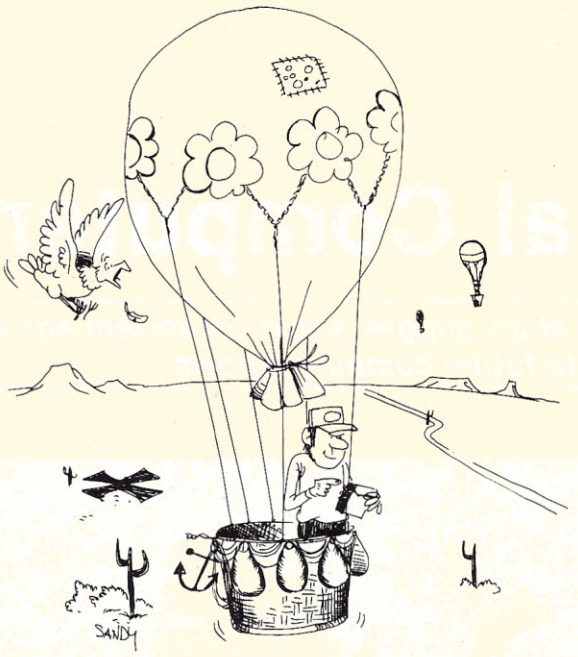
We had all the elements at the Computer Faire for a most enjoyable time—technical seminars for education, contests of computer chess for entertainment and display of new products to ponder and purchase—but something was missing. It's the same thing that is missing in most computer stores today: a guided tour . . . a menu . . . a flowchart. We need to display in the most obvious ways if we are going to bring our secrets of high technology to the public.

As our market matures from the technical activist to the consumer, so should our showmanship. Let's invite everyone to experience the personal-computer evolution in a format understandable to all. Let's bring back "The Greatest Show on Earth" in the form of "Computer Expo."

Let's not forget the obvious help available from the product we display. *Business Week* called them "smart machines"; seems to me they should display, entertain and sell themselves. "Isn't that right, HAL?" (HAL is the computer renegade that took over the spaceship and plotted the destruction of its master in the movie *2001: A Space Odyssey*.)

While push went to shove on the exhibit floor of Computer Faire, plans for a U.S. Personal Computer Show were being presented in a dimly lit suite at the Holiday Inn. The significant point was the format of manufactures being grouped in industry segments (hobby, home entertainment, small business, education and industrial). The product presentations were more an education on computers in the home, business, industry, etc., than attributes of one machine versus the next. Contests and interaction of man and machine were most obvious in the home-entertainment area. Retailers were in storefronts and classes on computer applications were filled with the naive.

With an organized and concerted effort we could bring this "Computer Expo" of the future to Main Street, U.S.A., today. Let's get the organizers and showmen of personal computing together. In combination, their resources would give you and me "The Greatest Show on Earth" in the 1970s.■



Cross-Country Balloon Trip

Take flight with this very entertaining game for you and your SR-52.

Mac Oglesby
RFD 3
Putney VT 05346

000	LBL E	Initialization
002	CMs	Clear registers R00 thru R19
003	— RCL 99 = x^2 $\sqrt[x]{y}$ 7 = STO 99	Process input and store for "seed"
015	1001 HLT	Display 1001 and wait
020	LBL A	Each press of A brings a new day . . .
022	RCL 99 — .2 =	Using subroutine 1', find direction
029	if pos 9'	wind blows toward. Easterly is
031	12 SBR 1' GTO 2'	heavily favored.
037	LBL 9'	
039	45 — 3 SBR 1'	Subroutine 1' was adapted from Peter
045	if pos 2'	Stark's pseudo random number
047	+ 360 =	generator in "SUBMARINE"
052	LBL 2'	(KILOBAUD Feb 1977 p. 70)
054	STO 01	Store direction in R01 (Θ)
057	1 SUM 19	Count days (increment R19)
061	SBR 1' STO 00	Find wind velocity (0 to 30) and store
066	÷ 100 + RCL 01 = Fix 2	Display wind direction and velocity
077	INV st flg 0 HLT	Authorize a launch and wait
081	LBL B	Press B to launch the balloon
083	if flg 0 3'	Error if launch not allowed
086	fix 0 D.MS STO 04	Round input to nearest integer and store
092	— 1 = X (RCL +/- +19) =	Check size of rounded input. Error if
104	INV if pos 3'	less than 1 or greater than 20
107	RCL 04 PR OD 00	Distance travelled (r) is now in R00
113	RCL 01 P/R D.MS SUM 03	Convert to rect. coords. Store y in R03
121	RCL 00 D.MS SUM 02	Store x in R02
128	(RCL 02 — 1001)x^2 + RCL 03 x^2 = $\sqrt{x}$	Compute distance from goal
146	— 15 =	Closer than 15?
150	if pos 4'	If no, continue the game
152	RCL 19 A' HLT	Game over! Flash number of days
157	LBL 4'	Game continues
159	+ 15 =	Repair distance to goal
163	st flg 0 HLT	Revoke launch permit and wait
166	LBL 3'	Error section
168	INV fix 1 ÷ 3 = A' HLT	Flash .3333333333
176	LBL 1'	Subroutine 1'
178	X 30 X ((7 y^x 9 X RCL 99 X .00001) — (RCL — .5)	
206	fix 0 D.MS) STO 99 = D.MS rtn	

Note: Angular mode switch must be set at "D"

Program listing.

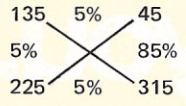
Your balloon starts 1001 miles (use kilometers if you wish) due west from your goal. Each day you are given the wind direction and velocity and decide whether or not to launch. If you choose to launch, you decide how long to stay aloft (from 1 to 20 hours). The game ends if you land closer than 15 miles from the goal. The number of days is flashed.

You will need paper, pencil, protractor and ruler. Using any appropriate scale, locate the goal 1001 miles due east from the start. The program uses the convention for directions that is shown in Fig. 1.

1. To begin a game, load the program and enter any number (6 digits or so).

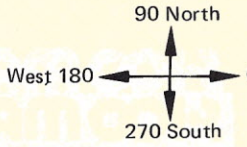
2. Press E. The display will show 1001, your distance from the goal.

3. Press A. The display shows the direction in which the wind is blowing and its velocity. The format is ddd.vv. Note: the wind blows mostly in an easterly direction. In fact, 85% of the wind direction will be between 315 and 45 (SE to NE). Of course, any game may differ from these expectations.



4. Make launch decision. If no, go to step #3 for next day's wind. If yes, enter a whole number from 1 to 20 and press B. Your balloon will travel that many hours. The display shows how far from the goal you landed. Plot your trip carefully. Go to step #3.

5. If you land closer than 15 miles from the goal, the display flashes the number of days. Press CE to stop the flashing. Go to step #2 for a new game. Flashing .3333333333 indicates an error (like if you specify a 22 hour flight). Press CE and try again. ■



(In terms of rectangular coordinates, you start at 0,0; the goal is at 1001, 0.)

Fig. 1. Conventional compass directions are used to form game board.

	Enter	Press	Display	
(R99 = 0)	1977	E	1001	
		A	354.12	
	20	B	762	
		A	347.13	
	20	B	516	
		A	337.28	
		A	327.20	
		A	333.18	
		A	7.18	
	20	B	157	
		A	318.24	
		A	42.10	
		A	6.27	
	4	B	53	
		A	342.09	
		A	349.28	
		A	352.14	
		A	18.15	
		A	36.04	
	13	B	Flashing 14	You arrived within the goal circle in 14 days. Final location was (998,3).

	Enter	Press	Display	
(R99 = 0)	354	E	1001	
		A	352.23	
	20	B	549	
		A	36.19	
	20	B	286	
		A	326.06	
	20	B	167	
	A	A	205.12	
		A	2.18	
		A	23.07	
		A	10.01	
		A	269.16	
		A	325.11	
	15	B	Flashing 9	
				Reached the goal in 9 days. Final location: (.997, — 3).

	Enter	Press	Display	
(R99 = 0)	408	E	1001	
		A	320.14	
	20	B	807	
		A	353.01	
		A	180.05	
		A	270.21	
		A	39.03	
		A	8.09	
	20	B	628	
		A	40.14	
	20	B	396	
		A	315.16	
	18	B	262	
		A	349.17	
		A	40.15	
	10	B	113	
		A	348.11	
		A	338.17	
		A	343.02	
		A	306.26	
		A	25.05	
		A	134.10	
	12	B	159	
		B	.3333333333 Flashing. Press CE	
		A	357.00	
		A	335.17	
	5	B	88	
		A	333.21	
		A	340.21	
		A	9.25	
		A	327.26	
		A	330.14	
		A	322.09	
		A	25.07	
	13	B	Flashing 25	
				Reached the goal in 25 days. Final location: (1001, 5)

Sample runs.

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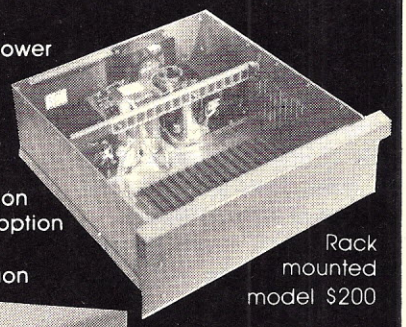

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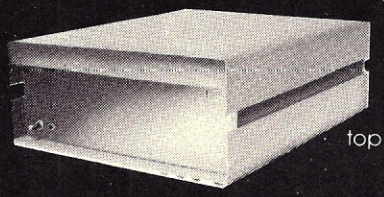

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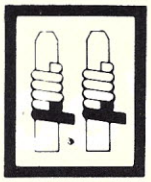

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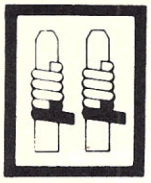

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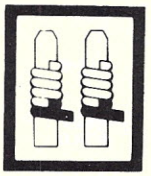

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Transfer Vectors vs Absolute Addressing

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William Nichparenko
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Those of you involved in heavy assembly language programming will find Bill's article very worthwhile. He's discussing the technique of using transfer vectors which, incidentally, was the subject of an article by Art Childs in Issue #1 of Kilobaud. *Art discussed the use of the transfer vector with regard to accessing I/O routines . . . Bill's approach deals with using the transfer vector as opposed to absolute addressing. – John.*

If you are not fortunate enough to have a sophisticated operating system, but would like to have some modular software that you can use with ease, the follow-

	Machine Language Hex Location	Operation Code	Label	Assembly Language Mnemonic	Operand	Comment
				ORG	$6F7	ORIGIN FOR OBJECT CODE
	6F7	7E 0802		JMP	C	JUMP TO LABEL C
	6FA	7E 07FA		JMP	B	JUMP TO LABEL B
	6FD	7E 0721		JMP	A	JUMP TO LABEL A
Entry →	700	CE E000	Z	LDX	$E000	BEGIN PRINT A ACCUM. SUB
	X	X X X		X	X	X X
	X	X X X		X	X	X X
	721	7D 01FF	A	TST	$1FF	BEGIN CARRIAGE MOVE SUB
	X					
	X					
	7FA	86 1F	B	LDAA	#$IF	BEGIN PAPER MOVE SUB
	802	B1 07A0	C	CMPA	$7A0	BEGIN END OF LINE CHECK SUB
	8A0	39		RTS		RETURN TO MAIN PROGRAM

Fig. 1. Assembly language representation of the module and the object code generated.

ing method may be of interest to you.

The Problem

Suppose you have a software module called Printer Control (known as the base module from here on). Fig. 1 is arranged so that the assembly language representation of the module and the object code (or machine language) that it generates are adjacent for easy comparison. This module has a reference entry point of 700 hexadecimal, used whenever entering the module by itself. The purpose of the module is to take a byte of information in the A accumulator, operate on it, and return to the main program when completed. This base module contains various subroutines within it (for illustration purposes call these subroutines A,B,C) that are useful to other modules. For example, a TAB module, entirely separate from the Printer Control module, may want to use subroutine A of the base module to perform a carriage movement without printing any letters. The problem that arises is that other modules, not having been assembled at the same time as the base module, must call the subroutines A, B, and C by absolute addresses (i.e., a machine code value in hex or octal as opposed to a symbolic address). This is fine as long as none of the addresses in our base module change. Unfortunately, any time you want to modify the base module, many of the subroutine call addresses in all the other modules using the base module subroutines may have to be changed. This is a time consuming and error prone process.

The Solution

A simple solution is to place a transfer vector (a collection of jump commands pointing to the locations of assembly language subroutine labels A, B, C) in front of the module's object code. The absolute address of the transfer vector never changes, but the addresses within the module that correspond to subroutines A, B, and C are changed every time the module is altered and reassembled.

If new subroutines are added to the module, a new jump instruction is appended to the transfer vector so as to not change the absolute addresses of the jump instructions contained in its earlier versions. The only thing that need be remembered is to arrange the assembler origin such that the reference entry point to the module does not change.

Fig. 2 shows how various addresses might change with addition of a new subroutine, labeled D, to the module. Note that a new assembler origin of 6F4 is necessary to maintain the absolute addresses of the old transfer vector and the reference entry point of the base module (three additional bytes of memory are needed for each new jump instruction). Note also how the absolute addresses of each subroutine have changed, and how the corresponding jump command operands in the transfer vector have changed accordingly. A subroutine call to location 6FA will enable the use of subroutine B in either the old or the new edition of the base module.

Fig. 3 shows how the base module can be used in any one of the three possible modes. The first mode is a direct call to the base module at location 700 hexadecimal. This uses the full capability of the base module to call each of the three subroutines A,B,C as needed. An important point to note is that each of the subroutines within the base module must have its own return command in order to be useful outside the base module. Upon completion, the base module returns control to the main program.

The next call from the main program illustrates the use of the transfer vector to call subroutine B in the base module. Finally a direct call to subroutine C at its absolute address illustrates what we are trying to avoid by the use of a transfer vector. If the address of C changes due to a modification in the base module, so must the absolute call in every main program that uses subroutine C directly. ■

	Machine Language			Assembly Language		
	Hex Location	Operation Code	Label	Mnemonic	Operand	Comment
New routine added. →				ORG	$6F4	ORIGIN FOR OBJECT CODE
	6F4	7E 0762		JMP	D	JUMP TO LABEL D
Old addresses still valid.	6F7	7E 0843		JMP	C	JUMP TO LABEL C
	6FA	7E 0811		JMP	B	JUMP TO LABEL B
	6FD	7E 0721		JMP	A	JUMP TO LABEL A
Entry point unchanged. →	700	CE E000	Z	LDX	$E000	BEGIN PRINT A ACCUM. SUB
	X	X X X		X	X	X X
	X	X X X		X	X	X X
	721	7D 01FF	A	TST	$1FF	BEGIN CARRIAGE MOVE SUB.
	762	BB E000	D	ADDA	$E000	BEGIN PAPER OUT CHECK SUB
	811	86 1F	B	LDAA	#$1F	BEGIN PAPER MOVE SUB
	843	B1 07A0	C	CMPA	$7A0	BEGIN END OF LINE CHECK SUB
	921	39		RTS		RETURN TO MAIN PROGRAM

Fig. 2. Address changes with new subroutine (D).

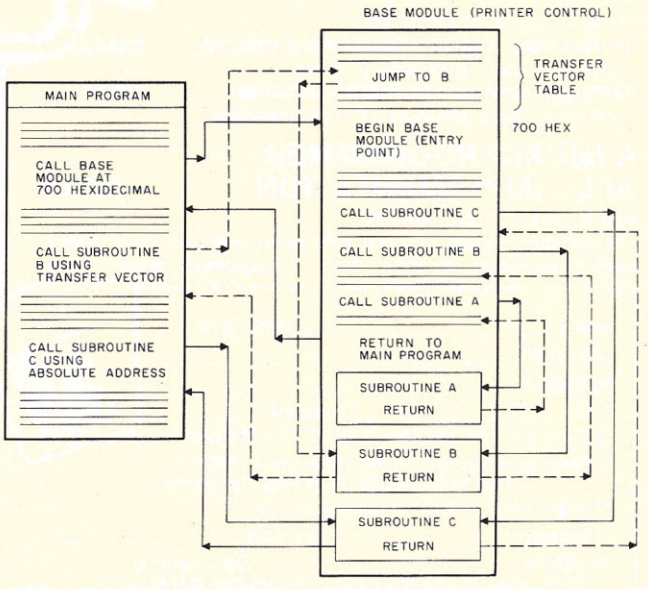

Fig. 3. Various uses of base module.

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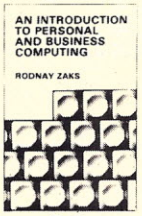

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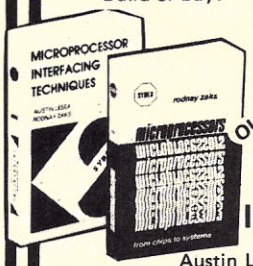

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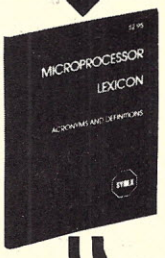

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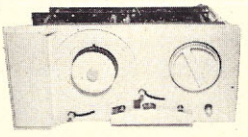

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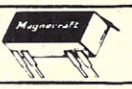

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Error Correcting Codes

Error correcting codes are a software technique for detecting and correcting hardware errors that sometimes occur in data-transmission systems.

Most of us are familiar with detecting errors using a parity bit. The ASCII 7-bit code is usually accompanied by an 8th bit which is set either as 0 or 1 depending on whether the first 7 bits have an even or odd number of bits turned on (or set to 1). The kind of parity is either even or odd depending on whether or not the entire 8 bits have an even or odd number of bits on. Since the 8th bit is set on or off as a result of the first 7 bits, every set of 8 bits can be sent with the identical parity. At the receiving end, all we need to do is check each 8-bit string for its parity; when one comes along with the wrong parity, we have detected an error. Unfortunately, we have no idea which bit has been clobbered in the channel, and therefore we must request that the string be retransmitted.

Checksums perform the same sort of basic function (detecting errors), but they too suffer from the inability to indicate where the error(s) occurred. Also, since checksums occur after several strings of bits have been sent, a checksum error means that the whole message must be resent. If the channel is subject to much noise, we can expect at least a few errors in a long message, and we may end up sending and resending the message several times before an error-free message is received.

bit 1	bit 2	result
0	0	0
1	0	1
0	1	1
1	1	0

Table 1. Truth table for the Exclusive OR operation.
One way to interpret this operation is to view the result as a parity bit which results in even parity. Thus, if we have a string of bits such as 001011 and perform the Exclusive OR $0 \oplus 0 \oplus 1 \oplus 0 \oplus 1 \oplus 1$ the result would be 1. Being able to do Exclusive ORing on a string of bits is necessary when more bits are involved in each message string (more than just one like in this first example). Another way to get the result of a string of EX ORs is to find out how many 1s there are, and if the number is even, the result is 0; if the number is odd, the result is 1.

With a few extra parity bits interspersed throughout the string of bits, we can not only detect errors but also locate the bit in error, invert it, and have a correct message received without having to send the message more than once. This sort of parity checking (with extra parity bits) is known as error correcting, a bit more sophisticated and helpful than simply error detecting.

Error Correction — Needs More Parity Bits

In order to have a coding scheme that not only detects errors, but corrects them, it seems only natural to have to pay a price. The price is in terms of extra parity bits. For short strings of bits, the parity bits occur almost as frequently as the message bits. In fact, to send a single bit and detect and correct errors, two parity bits are required. An example will help clarify this point, but in words we must be aware of the fact that errors can occur in the parity bit(s) as well as

Position Binary Address	
0 = 0 0 0	
1 = 0 0 1	P
2 = 0 1 0	P
3 = 0 1 1	M
4 = 1 0 0	P
5 = 1 0 1	M
6 = 1 1 0	M
7 = 1 1 1	M

Table 2. The parity bits are at positions in which only a single bit is on. Look down a column. Wherever there are 1s in the column, note the positions. There will only be one parity bit in each column and three message bits. (In general, $(2^{n-1}-n)$ message bits will be used to encode each of the n parity bits.)

in the message bit(s). If such an error does occur, we want to be sure that we don't assume that the message bit was in error and invert it by mistake.

One Message Bit

Suppose we have only one bit to send, which we shall label as M. The error correcting code will have three bits in total: M and two parity bits, P_1 and P_2. The string will look like MPP, or better, $M_3P_2P_1$ with the subscripts indicating which bit is sent first. M_3 means that the message bit will be the third bit in the string. Now we must know how to encode the parity bits P_1 and P_2.

The error correcting code discussed here depends heavily on the use of the Exclusive-OR logical function (see Table 1). The notation $\oplus$ will be used to indicate Exclusive-OR.

Let's set $P_1=M_3$ and $P_2=M_3$ and see what happens. If the message is M=1, the string will be 111. Now at the receiving end, the string is analyzed by determining the results of the Exclusive OR checks shown in Example 1.

Believe it or not, this check indicates that there is no error in the string. Reading from the top down, the two 0s indicate that error occured in the 0th bit (which does not exist).

One Message Bit — One Error

If an error in transmission had occurred, one of the bits in the message would have been a 0 instead of a 1. If the first bit were the source of error, the received message would have been 110 and the check would have given Example 2. This indicates that the error occurred at location 01 binary, or the first bit (which we knew because we made the error in bit 1). If the error occurred in bit 2, the received message would have been 101 and the check would be Example 3. This indicates an error in bit 10 or bit 2 (10 is binary for 2). Of course, had the error been in the third bit, or message bit, the check would reveal 11 which is binary for 3.

$$A_1 = P_1 \oplus M_3 = 0$$

$$A_2 = P_2 \oplus M_3 = 0$$

Example 1.

$$A_1 = P_1 \oplus M_3 = 1 \oplus 1 = 0$$

$$A_2 = P_2 \oplus M_3 = 0 \oplus 1 = 1$$

Example 2.

$$A_1 = P_1 \oplus M_3 = 0 \oplus 1 = 1$$

$$A_2 = P_2 \oplus M_3 = 1 \oplus 1 = 0$$

Example 3.

$$P_1 = M_3 \oplus M_5 \oplus M_7$$

$$P_2 = M_3 \oplus M_6 \oplus M_7$$

$$P_4 = M_5 \oplus M_6 \oplus M_7$$

Example 4.

Several Message Bits

There are some fixed number of message and parity bit combinations which are not possible in this single error correction coding scheme. In general, it is the number of parity bits which fixes the number of message bits included in each distinct string of bits. The number of bits in a string is 2^n-1 where n is the number of parity bits. For the two parity bit example, 2^2-1 = 3, the total number of bits in the string. The number of message bits in the string is, therefore, (2^n-1) - n. What does this mean if we try 3 parity bits instead of 2? Plugging in we get 2^3-1-3 = 4 message bits. Thus, the string will be 7 bits long, and there will be 4 message bits and 3 parity bits. Let's jump to 5 parity bits. In this case, there will be 31 bits in the message, and 26 message bits. The ratio of information (message bits) to checking (parity bits) improves as the strings get longer. But as we will see, the amount of processing needed during encoding and decoding also increases as the length of the string increases.

In this example using 7 bits (4 message and 3 parity), we will assume that you understand the Exclusive OR operation and binary notation. The first problem is to locate where the parity bits belong. Mathematically, they are put in locations 2^0, 2^1 and 2^2 which is easily generalized, meaning that for n parity bits, the ith one belongs in position 2^{i-1}. For our three parity bits, this means they are the first, second, and fourth bits in the string. The message bits are put in the unused positions, which are 3, 5, 6 and 7.

To determine the coding for the parity bits we'll give you a scheme later. For now, just the notation will do. First, our string will look like this:

$M_7\ M_6\ M_5\ P_4\ M_3\ P_2\ P_1$

and is sent out by shifting it to the right one bit at a time (e.g., serial transmission across the phone lines or into a cassette recorder). The parity bits are determined using the message bits in Example 4.

This may appear at first to be sort of random, but look closely. The parity bits occur at positions such that any combination of 0s and 1s for them will encode a binary address from 0 to 7 by adding up the position numbers (which we will find out is the address of the bit which is in error). Also, the positions of the message bits are such that only those in which bit 1 is on (for positions 3, 5, and 7 in binary) are used to encode parity bit P_1. P_2 is encoded using the message bits in locations in which the second bit of a three bit binary address is coded as 1, which are positions (addresses) 3, 6 and 7. Likewise, P_4 uses the bits located in positions in which the third bit of a three bit binary address is 1. A look at the list of numbers in Table 2 will help.

The position 0 (000 binary) is not used during the encoding. For the rest of the table, the columns are the key thing to look at. The parity bit being encoded will be associated with three message bits, found by the positions in which a 1 is found in the column along with the 1 associated with the parity bit. The first parity bit is in position 1, and in that column, positions 3, 5, and 7 also have a 1.

The next step is to take a message (any 4-bit message will do) and encode it into a 7-bit string. I chose the message 0111 which is hex 7. (The important thing to keep consistent is which way to read the message. The bits are to be shifted right if they are serialized.) In this 4-bit message, the individual message bits are: M_3 = 1, M_5 = 1, M_6 = 1, M_7 = 0. The parity bits are shown in Example 5. The entire string of bits will be (starting with bit 7 on the left) 0110100.

$$P_1 = 1 \oplus 1 \oplus 0 = 0\ (= M_3 \oplus M_5 \oplus M_7)$$

$$P_2 = 1 \oplus 1 \oplus 0 = 0\ (= M_3 \oplus M_6 \oplus M_7)$$

$$P_4 = 1 \oplus 1 \oplus 0 = 0\ (= M_5 \oplus M_6 \oplus M_7)$$

Example 5.

$$A_1 = P_1 \oplus M_3 \oplus M_5 \oplus M_7 = 0 \oplus 1 \oplus 1 \oplus 0 = 0$$

$$A_2 = P_2 \oplus M_3 \oplus M_6 \oplus M_7 = 0 \oplus 1 \oplus 1 \oplus 0 = 0$$

$$A_4 = P_4 \oplus M_5 \oplus M_6 \oplus M_7 = 0 \oplus 1 \oplus 1 \oplus 0 = 0$$

Example 6.

Now let's send this message with no errors. At the receiving end, the string is processed by performing Example 6. The address of the error is 000, or position 0, which is not in the string. If none of the bits have changed during transmission (no errors) then it makes sense that each of the Exclusive ORs should result in 0s. Remember, P_1 was the result of ($M_3 \oplus M_5 \oplus M_7$) and therefore, doing the checking is like doing the following: ($M_3 \oplus M_5 \oplus M_7$) $\oplus$ ($\overline{M}_3 \oplus \overline{M}_5 \oplus M_7$) where the M means the received message bits. We can reorient this expression as ($M_3 \oplus \overline{M}_3$) $\oplus$ ($M_5 \oplus \overline{M}_5$) $\oplus$ ($M_7 \oplus \overline{M}_7$) which compares each message bit before and after transmission. If no change has resulted, the $\oplus$ will be 0 for each pair (a bit $\oplus$'d with itself is 0), but if a single bit has inverted due to error, the result will be a 1. Studying this a bit longer (no pun intended) will show you how the scheme will give you the actual position of the error.

$$A_1 = P_1 \oplus M_3 \oplus M_5 \oplus M_7 = 0 \oplus 1 \oplus 0 \oplus 0 = 1$$

$$A_2 = P_2 \oplus M_3 \oplus M_6 \oplus M_7 = 0 \oplus 1 \oplus 1 \oplus 0 = 0$$

$$A4 = P_4 \oplus M_5 \oplus M_6 \oplus M_7 = 0 \oplus 0 \oplus 1 \oplus 0 = 1$$

Example 7.

$$P_1 = M_3 \oplus M_5 \oplus M_7 \oplus M_{11} \oplus M_{13} \oplus M_{15} \oplus M_{19} \ldots \oplus M_{31}$$

Example 8.

$A_1 = 01010101$ $\quad \overline{A}_1 = 10101010$

$A_2 = 01100110$ $\quad \overline{A}_2 = 10011001$

$A_4 = 01111000$ $\quad \overline{A}_4 = 10000111$

(The bar means not or complement, or in this case, when A_n = 0.)

Example 9.

A 7-Bit String with One Error

Using the same message bits as before, let's find out what we'd do if we received the following message: (don't look back at the original string just yet) string = 0100100. We know this is a 3 parity bit code, and the parity bits are in locations 1, 2 and 4, thus $P_1 = 0$, $P_2 = 0$, and $P_4 = 0$. Also, the message bits are $M_3 = 1$, $M_5 = 0$, $M_6 = 1$, and $M_7 = 0$. Now let's decode the address of the error, if any, in Example 7.

The address of the error is position 5, read from A_4 and A_1, both being on; their sum is 5. Now correct the string to read 0110100 (invert position 5's bit from a 0 to a 1) which is the proper string. The message bit was in error in this case, but in others, the parity bit may have been the one in error. Rather than correcting the string, it might be quicker and more efficient simply to check the address to determine whether parity or message bits were involved and ignore the correction if a parity bit was in error (who cares about parity bits after the message has been sent?).

Try doing the error checking for other position errors. Also, where there are two errors, this system will not locate the address of the error, but it will indicate that an error was received (one or more of the error address bits will be on). This error correcting code will handle most errors as long as the error rate is fairly small (so that two errors are not likely to occur in the same string).

What to do with Error Correcting Codes

The 7-bit string used in the example only allows 4 message bits to be sent with each 3 parity bits. This sounds inefficient, and in terms of getting a lot of data through a channel it is. However, it helps eliminate an occasional missing bit, which may be even more disastrous than a slower effective bit rate. With 5 parity bits, the relative number of parity bits is substantially reduced compared to the number of useful data bits. The 31 bits in a string result in 26 message bits, which is enough to encode 3 8-bit bytes with 2 extra bits which are of little use. The problem with the 31 bit message is the number of Exclusive ORs needed. For example, the first parity bit is found using the calculation in Example 8.

Another problem for the programmer is how to do bit-specific Exclusive ORing efficiently. Hopefully, an article will appear describing a program to implement the 7-bit string error correcting coding in the near future. As a start on the programming, put masks in memory as shown in Example 9.

If it is determined that the location of the error is A_1=1, A_2=0, A_4=1, then use the AND function to AND A_1, $\overline{A}_2$, A_4 which will result in the following mask in the Accumulator: 0001000. Simply $\oplus$ this with the received string, and the proper bit will be inverted, which is bit 5. Note also that by ANDing A_1 with the string, only bits 1, 3, 5 and 7 can get into the Accumulator, at which time you need only to determine the parity (number of 1 bits) and if it is even, the result will be 0 indicating that as far as the A_1 portion of the position, use $\overline{A}_1$ mask. Whether to use A_2 or $\overline{A}_2$ mask, AND A_2 with the string, determine the parity, and select A_2 or $\overline{A}_2$ depending on whether the results are odd or even respectively. ■

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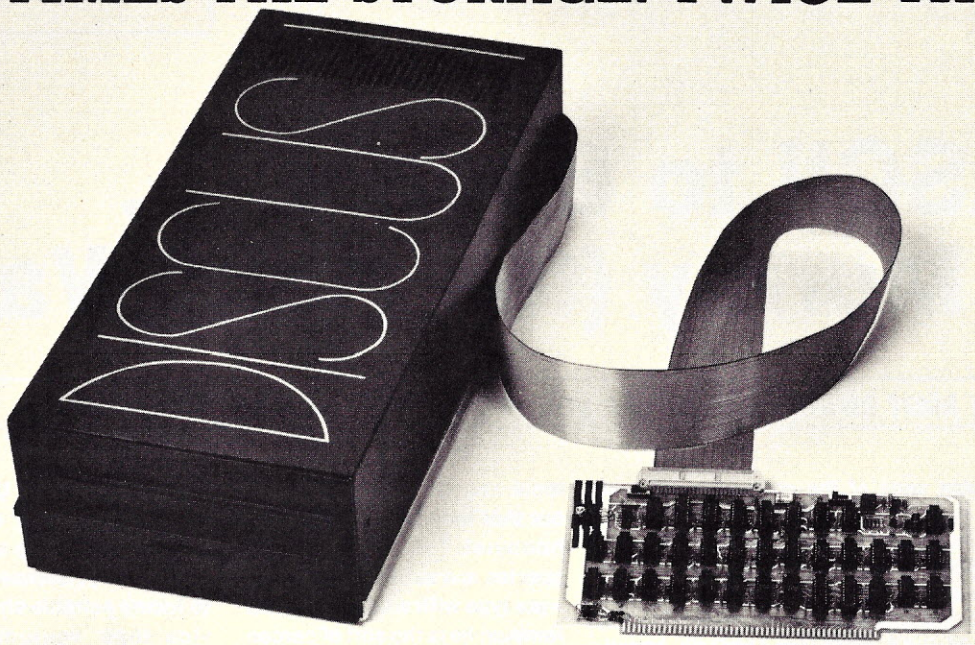

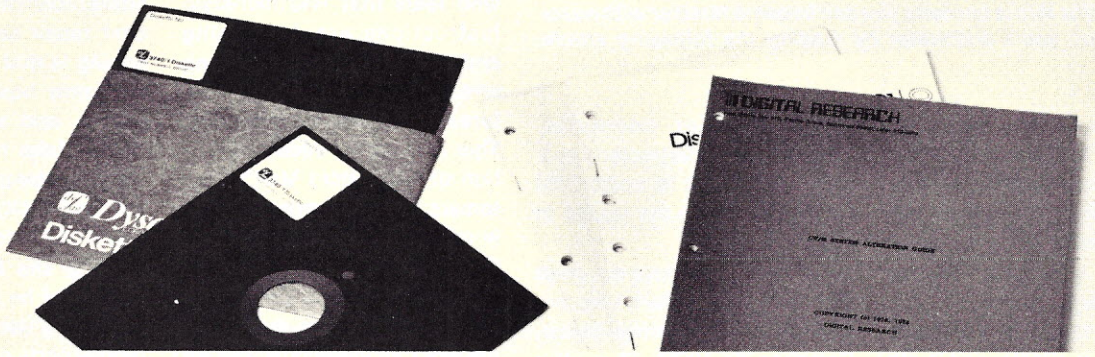

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Ray Graham
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Ypsilanti MI 48197

Publisher's note: *The Baudot referred to in this article is actually Murray code as per my remarks on page 4. Have we all been the victim of a dastardly French revisionism plot?*

ASCII to Baudot . . . er . . . Murray (the Hard Way)

Mini Micro Mart strikes again—as you will see in this consumer report.

And so it goes—the continuing saga of the computer hobbyist community and its special relationship with Mini Micro Mart. Naturally, you won't be able to get into this relationship until you order something from Mini Micro Mart; and then you'll find out (as John, Ray and so many others have) why it is a special *relationship. Without hesitation, I can recommend at least one product for you to buy from MMM: the GPA-B ASCII/Baudot converter board. The reason for this is because you can become familiar with possible problems you'll encounter by reading the following article. —John.*

The Mini Micro Mart GPA-B is a kit that converts parallel ASCII to serial Baudot. This is obviously a very useful device for hams and computer hobbyists who have Baudot teleprinters, such as the models 15, 19 and 28. These are frequently available and quite inexpensive; many hams have them already. Conversion from ASCII to Baudot can be done in either hardware or software; a hardware conversion system can save a couple-hundred bytes to be used for other purposes in your computer. Whether this particular hardware conversion is worthwhile will be left up to the reader to judge—read on!

For those who have not dealt with Mini Micro Mart, they are located at 1618 James Street, Syracuse NY 13203. They offer quite a range of computer equipment, both surplus and kits, at very low prices. Cynics might observe here that you usually get what you pay for; this is not far from the truth.

One of Mini Micro Mart's most recent bulletins points out that they cater to the "true hobbyist." This particular species is a subset of the hardware type with whom we are all familiar; he is the sort of person who feels that Heathkit-style instructions are demeaning and that (one gathers) finding errors in design and manufacture is an interesting challenge. This is a rather recent definition of Mini Micro Mart's customers; it did not exist (at least in print) when I bought the kit. But since they specify who their ideal customers are, let us now explain who we are so that readers can judge how well we fit the mold.

"I" in the rest of the article refers to John, K8UP (as in microprocessor). I am a ham (since 1964) with the usual experience with a combination of home-brew, kit and commercial ham gear. Digital electronics is fairly new to me, although I have been programming computers for a couple of years now. As a computer hobbyist, I am definitely a "software type."

Ray is a hardware type—an electronics technician by profession, as well as by avocation. His background, like mine, is mostly in communications electronics. We are both members of the Ann Arbor Computer Club, which is the source of this collaboration.

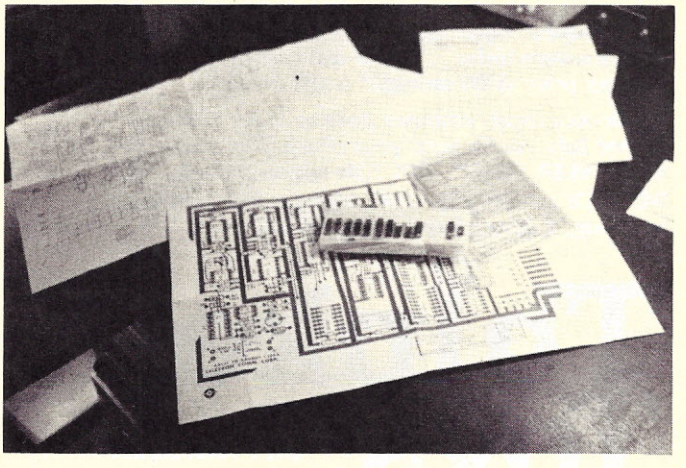

Photo 1. What was shipped.

More on MMM

Mini Micro Mart does not service what it sells. Until a few months ago, their customers were forced to live a catch-as-catch-can existence scurrying to locate suitable shops to service their equipment; now MMM recommends an independent repair service. Their reasoning is that some people do not know how to put kits together, and so the company cannot take responsibility for resulting errors. My own opinion (for what it is worth) is that if MMM took responsibility for making the kits work, they would not be able to send out erroneous documentation, defective parts or incomplete kits the way they do now.

What I received in this instance is pictured in Photo 1; documentation consists of a parts list, a schematic and a layout diagram. The schematic and the layout (at least for this kit) were not in agreement. Part of the reason for this seems to be that MMM makes several ASCII/Baudot conversion boards . . . and they use the same documentation for all of them!

Only by comparing the parts shipped with the parts list (which again does duty for three kits) and figuring out what everything on the schematic does is it possible to figure out what is needed for the GPA-B kit. For those who have trouble, a corrected schematic is given in Fig. 1. This modification contains additions and corrections (more on

these later) but does not include the parts for different kits. Incidentally, I never did receive all the parts for this kit; fortunately, the missing ones were available locally. If this keeps up I may turn into a true hobbyist!

Now for the history of the kit. The circuit was originally published in *Radio Electronics* in March 1976. In the original publication there were a couple of errors, which were corrected the next month. Not all of these are corrected in the GPA-B (I presume that the folks at Mini Micro Mart do not believe in testing their kits before they put them into production and sell them).

I ordered the kit (for $35), along with a surplus keyboard, in early February 1977. The keyboard came a few weeks later with a note that the GPA-B would be delayed about a week. After a month of waiting, I wrote the company to ask what had happened. No answer. Two months from the time the keyboard arrived, I again wrote. This time I was informed that the board had not been shipped because MMM didn't have any. They did have a similar board . . . would I accept that? I said yes.

Three weeks later at a computer fair in Cleveland, I ran into Mini Micro Mart representatives who said they didn't have any of the boards yet (they had one as an exhibit and were taking orders for them), but that it wasn't their fault and they would ship one right away. They were obviously not too enthused about my scaring away customers, although a couple of other people at the show commented that they, too, were having problems with orders.

Two weeks later, still nothing. I called. Yes, they had them and one would be sent the next day. A few weeks later it came —over four months from the time I ordered it (prepaid, of course). I read the directions (half page), checked for non-plated-through holes with a magnifying glass (I should have used an ohmmeter) and built the thing—after going out and buying IC sockets. It didn't work.

First, I compared all parts with parts layout. No problem. Then, using an ohmmeter, I compared the schematic to the board. In addition to the unplated-through holes I had caught with the magnifying glass, there were 27 additional holes that had either been bad to begin with or had come unplated when I inserted the IC sockets. I repeat: *twenty-seven* bad plated-through holes. Ray later found three more; it would have been much easier if the kit had been sold as not having plated-through holes, then I would have soldered everything on both sides to begin with.

"Mini Micro Mart recognizes a responsibility to provide the highest quality components, whether sold as individual items or as part of a kit." So reads the manual. Yep. I might add that Mini Micro Mart not only recognized its responsibility to provide the highest quality components in the form of

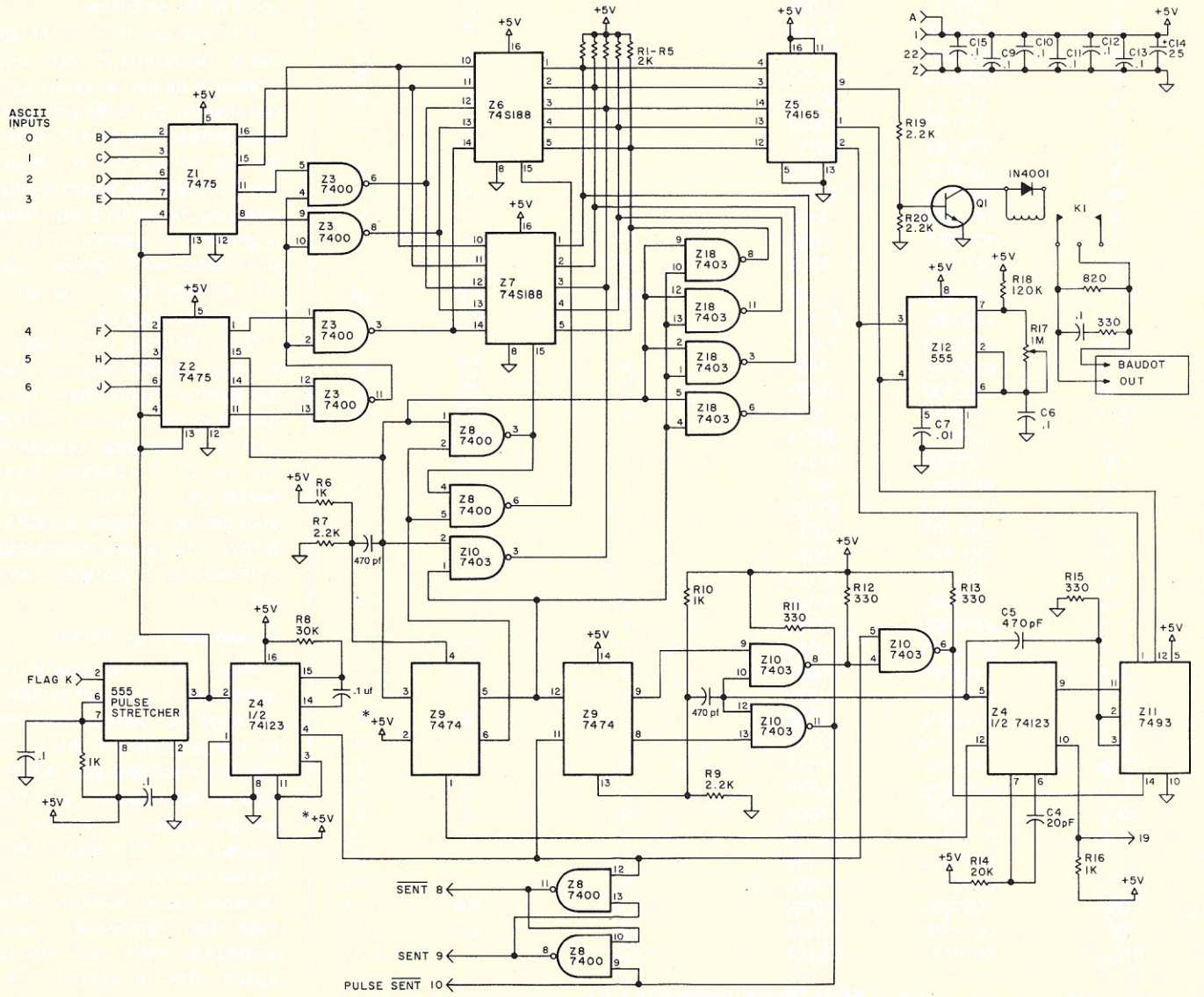

Fig. 1. Mini Micro Mart GPA-B ASCII-Baudot conversion board. Schematic modified by John Lehman and Ray Graham.

the board, but also included three bad ICs. We replaced them locally, rather than return them and risk waiting a couple more months.

After I had spent about 25 hours tracing pulses and soldering bad holes, I gave up and called Ray. He found a couple more bad holes, two bad ICs, in addition to the one I had found, and two errors in the schematic. Error here means something more serious than mislabeling a part or misnumbering an IC pin, which also happened.

The first problem was that the clear pins on the 74123 were left floating, rather than being tied high. Although not exactly an error, this is not considered good practice because the pins are susceptible to noise. They were tied high as shown on the corrected diagram.

The second problem was that pin 2 of the 7474 was grounded rather than high. This causes the board to shift from figures to letters, but not shift from letters to figures. This was an error in the original unit. After many hours of work, Ray corrected the problem and brought the unit back to me.

I plugged it in expecting no problems. No such luck; I was plagued by the same problems that Ray had already solved. A couple of hours of circuit tracing were unproductive, but I did notice that the transformer on my bench supply was getting *very* hot. I checked the voltage with the GPA-B connected and read 4.75 volts. So I quickly built another supply with heftier components. This solved some of the problems.

It turned out that the 74123 did not work at 4.75 volts, but worked quite well at 5 volts. Unfortunately, the 74165 shift register worked fine at 4.75 volts, but did not work at 5. We replaced it and the board finally drove my model 15. Both of the original ICs worked fine in Ray's setup with unknown voltage, so they seem to be fairly sensitive to such things.

One additional modification is shown on the diagram: the 555 pulse stretcher shown connected to the flag. It turns out that my Sanders keyboard (ironically, purchased from MMM) did not have a long enough flag to trigger the GPA-B circuit. This pulse stretcher is optional, but it probably can't hurt.

Up and Running—Finally

Now that the board is operating, it is an acceptable, although not perfect, solution to the problem of driving a Baudot teleprinter with ASCII. One of the problems is in the design—space is always in figures shift. This means that the machine shifts and unshifts between each word—a less than ideal occurrence. It also sometimes shifts but fails to space when a space is received. If the board is run continuously for very long it gets

ASCII Symbol	Bits	Baudot Bits	Communications	CCIT	Bell
A	1000001	00011	A	A	A
B	1000010	11001	B	B	B
C	1000011	01110	C	C	C
D	1000100	01001	D	D	D
E	1000101	00001	E	E	E
F	1000110	01101	F	F	F
G	1000111	11010	G	G	G
H	1001000	10100	H	H	H
I	1001001	00110	I	I	I
J	1001010	01011	J	J	J
K	1001011	01111	K	K	K
L	1001100	10010	L	L	L
M	1001101	11100	M	M	M
N	1001110	01100	N	N	N
O	1001111	11000	O	O	O
P	1010000	10110	P	P	P
Q	1010001	10111	Q	Q	Q
R	1010010	01010	R	R	R
S	1010011	00101	S	S	S
T	1010100	10000	T	T	T
U	1010101	00111	U	U	U
V	1010110	11110	V	V	V
W	1010111	10011	W	W	W
X	1011000	11101	X	X	X
Y	1011001	10101	Y	Y	Y
Z	1011010	10001	Z	Z	Z
SP *	x100000	00100	SP	SP	SP
! a	x100001	01101	!	□	1/4
" b	x100010	10001	"	+	"
# c	x100011	10100	#	⊠	#
$ d	x100100	01001	$	⊡	$
& f	x100110	11010	&	⊟	&
' g	x100111	01011	'	BELL	'
(h	x101000	01111	(	(	1/2
) i	x101001	10010	)	)	3/4
, l	x101100	01100	,	,	7/8
- m	x101101	00011	-	-	-
. n	x101110	11100	.	.	.
/ o	x101111	11101	/	/	/
ø p	x110000	10110	ø	ø	ø
1 q	x110001	10111	1	1	1
2 r	x110010	10011	2	2	2
3 s	x110011	00001	3	3	3
4 t	x110100	01010	4	4	4
5 u	x110101	10000	5	5	5
6 v	x110110	10101	6	6	6
7 w	x110111	00111	7	7	7
8 x	x111000	00110	8	8	8
9 y	x111001	11000	9	9	9
: z	x111010	01110	:	:	1/8
;	x111011	11110	;	=	3/8
?	x111111	11001	?	?	5/8
CR	0001010	01000	CR	CR	CR
LF	0001010	00010	LF	LF	LF
BELL f	0000111	00101	BELL	'	BELL

*X = 1 or 0

Fig. 2. ASCII-Baudot conversion table.

very hot, and sometimes prints garbage. All of that TTL draws a fair amount of current; you could almost fry eggs over the PROMs.

Photo 2 shows the result of the project—a model 15 that works in parallel ASCII. Fig. 2 shows the ASCII/Baudot translation performed by the board. For those who are unfamiliar with Baudot teleprinters, the reason for the three columns is that there are a number of different sets of figures symbols for Baudot teletypewriters. The three illustrated are the most common (aside from the weather keyboard, which contains numerous meteorological symbols).

The communications style is the unofficial standard and the style the GPA-B was designed to match. The CCIT is probably the most common commercial keyboard around at present. The Bell keyboard is found on old Telex machines. When assembling the kit, be sure to put the PROM labeled "L" (Letters) on the top of the board and the PROM marked "F" (Figures) underneath it. This is not mentioned in the directions.

Conclusion

Ray has three boards from MMM (two of them from a PC-board supplier who no longer makes things for MMM). He got them a couple of years ago and has no complaints about the quality. None of these have been powered up yet, so I can't comment on how well they work.

I don't really enjoy trouble-shooting hardware, especially when the problems come from other people's mistakes and carelessness. Had I worked overtime for the amount of time I spent on this kit, I could have bought another computer and done the conversion in software.

Considering delivery, quality and design, I shall let you guess when I will buy anything more from Mini Micro Mart. Of course, if the winter is cold enough, you never know what might freeze over! ■

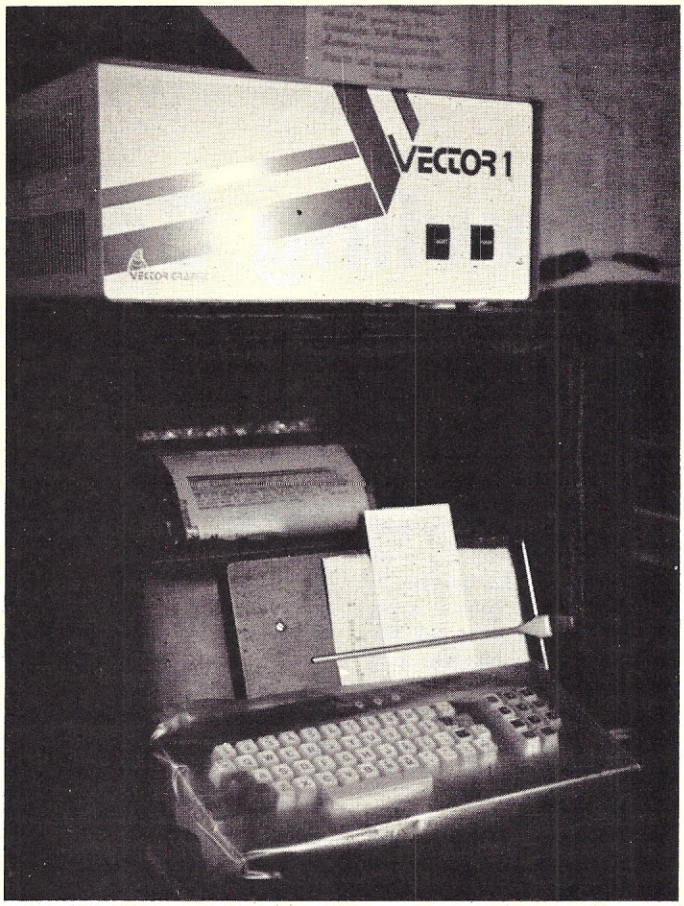

Photo 2. The final result.

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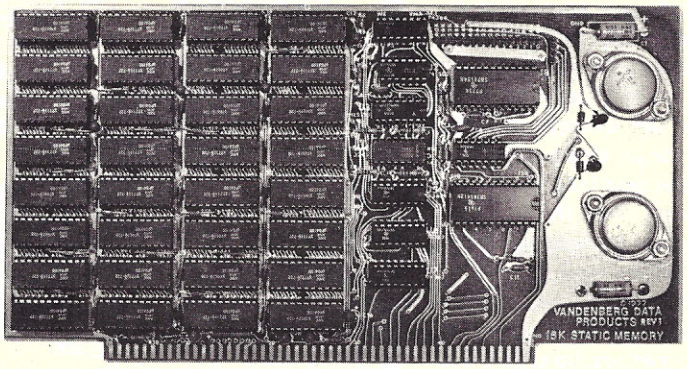

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Bowling Scores for Dollars

There's money to be made from this sport— and not just on the "bowling for bucks" TV shows. This article explains how.

Wow, what a package! This is very likely one of the best money-making ideas ever presented in the pages of Kilobaud. *If you give it a go, we'd be interested in hearing about your successes (and failures). Joe Roehrig will be happy to provide a copy of the program if you send him a blank minidiskette and $5. —John.*

Now that my micro data-processing system has been up and running for a year, it is time for the system to earn its keep and generate profits. Computers are specialists in handling large volumes of figures in a fast, accurate manner. Thus, a small businessman with a DP system should search for an application that processes data for a third party . . . saving the third party money while generating profits for the entrepreneur.

For the last 20 years, I have been bowling or scoring in bowling leagues. Up until a few years ago, scorekeepers manually tallied the scoring sheets for 50 to 75 cents per team per night. With 20 teams in a league, 36 weeks of bowling a year and a 50-cent rate, this fee comes to a modest $360 annually.

However, if a bowling center has three leagues per day, seven days per week, the gross scoring revenues come to $7560 per year. Taking this one step further, $151,200 worth of revenue could be generated by

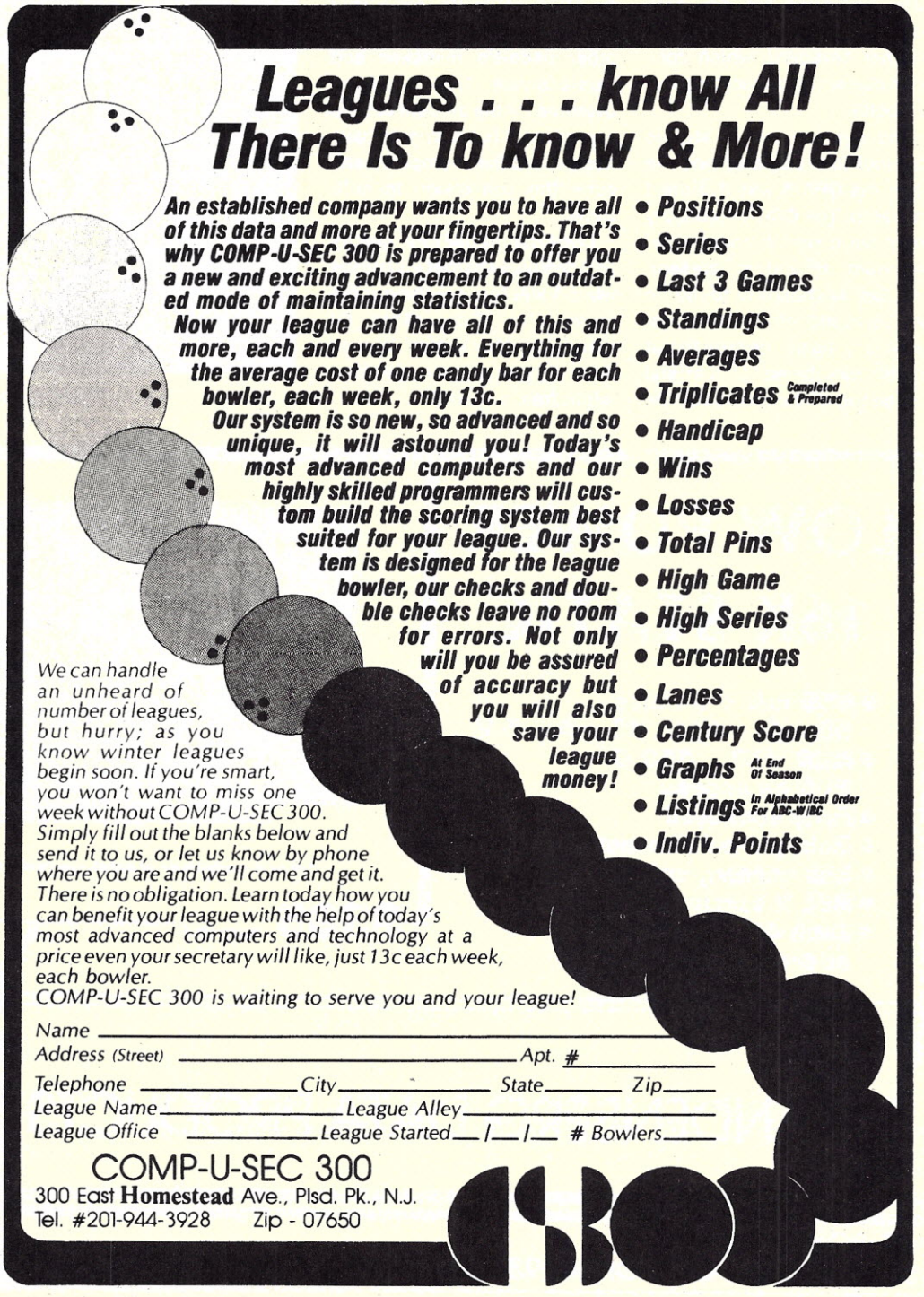

Fig. 1d.

Dear Manager,

We are happy to announce the start of a new service for bowling centers that can increase your revenue and facilitate the organization of bowling leagues within your center.

The service being offered is computerized statistics for your bowling league. Normally, this function is performed manually by a person who charges the league between 50¢ to 75¢ per team per week. Our service will be provided to the league through you at a cost of 35¢ per team per week. You, as the manager of a bowling center, can bill the league whatever amount you feel is appropriate. Assuming you charge the league 75¢ per team per week and have three leagues per day with 20 teams each, you would be increasing revenues by $315 per week. Your profit would be $168 and $147 would be paid for our service. We used a 75¢ price to the league in our calculation since our service is superior to anything done manually.

What will you have to do? Very little. The following is a step-by-step outline of the easy procedure:

1. Return the enclosed postcard telling us how many leagues you want us to service and approximately how many teams in each.

2. We will send you forms to give out on opening night of your league. The bowlers will enter their names and average on these sheets. (After opening night your bowlers will never enter their names on a score summary again . . . our computer will print this information for the remainder of the season.)

3. Fill out a simple form describing the league's rules or send us the league rules. Give us a schedule or ask us to formulate a schedule.

4. Collect the forms.

5. We will collect the forms weekly from you for computer processing or supply an envelope for their mailing to us depending on your volume. At time of collection you will be required to pay for one week's data processing (35¢ per team).

6. The weekly statistics will be delivered to you.

We will attempt to verify all ABC averages and will prepare a year-end list of averages for ABC filing.

Regarding our background, the person assigned to this project has been involved in bowling, bowling scorekeeping and league statistics for nearly 20 years. We can handle any size league, any number of players per team and any set of rules. If you ever become dissatisfied with our service, you can terminate immediately and we will supply you all our data on your league.

Attached is a very short sample of a four-team league and a copy of a weekly score sheet to be filled out by the teams. These are just samples, and actuals will be on four-part paper.

If you want more details, give us a call or just return the enclosed postcard.

Sincerely,

Joseph J. Roehrig

Fig. 1a.

servicing 20 bowling centers.

The problem now is marketing the idea. The approach I recommend is to deal with the bowling center directly and share the revenue fifty-fifty. Why so generous? Because without the cooperation of the center to recruit leagues and to collect scores for the scoring service, there would be no revenues at all. Fig. 1a shows a sample letter that could be sent to numerous bowling centers. A second approach, advertising in bowling trade publications, is shown as Fig. 1d. A person with time to visit the bowling centers could do person-to-person marketing.

After reviewing Fig. 1 and thinking about your share of $151,200, you should be ready to see how your new business runs, assuming your marketing has been successful and the customers are clamoring for your service. (The tools I use for processing bowling scores are an Imsai 8080, North Star Disk, 24K of memory, DECwriter, an ADM3, North Star BASIC and the software contained in this article.)

The first question is how to store the data. Initially, my North Star Disk was generating a lot of hard-disk errors (a hardware problem later corrected by the local computer store). Therefore, the software design kept disk reads and writes to a minimum during program executions by assigning an area of memory exclusively for examine and fill (peek and poke in Altair BASIC) operations.

This article will not deal with the detailed design of the software, but will show the reader exactly how to use the programs presented.

*Fig. 1. The key to the entire operation lies in your marketing approach. Fig. 1a is a copy of the letter I sent out to various bowling centers. Fig. 1b is a sample of a four-team printout. Fig. 1c is a sample weekly score sheet to be filled out by the teams. Fig. 1d is a sample of another approach—an advertisement in a bowling publication (*The Sports Reporter*).*

NYAC MIXED 01/14/78

POS	TEAM		WON	LOST	WIN - LOSS PERCENTAGE	HIGH GAME	HIGH SERIES	AVERAGE	TOTAL WOOD
1	RED	(1)	9.0	5.0	.643	738	2112	677.00	4062
2	GREEN	(3)	7.0	7.0	.500	816	2448	734.50	4407
3	WHITE	(4)	7.0	7.0	.500	817	2304	762.67	4576
4	BLUE	(2)	5.0	9.0	.357	773	2162	655.33	3932

NAME	ENT	#G	H-G	H-S	WOOD	AVE	==	NAME	ENT	#G	H-G	H-S	WOOD	AVE
	1 RED						==		2 BLUE					
HARCOHE	140	6	110	330	642	107.0	==	GRANT	140	6	111	333	603	100.5
SANDY	135	6	121	360	701	116.8	==	TORRE	135	6	120	342	642	107.0
BROTHMAN	110	6	132	390	769	128.2	==	MILLAN	110	6	132	381	711	118.5
JOELLY	170	6	211	538	958	159.7	==	BERRA	170	6	220	541	961	160.2
SIMMON	180	6	181	542	992	165.3	==	MARTIN	180	6	190	565	1015	169.2
							==							
	3 GREEN						==		4 WHITE					
MANTLE	140	5	131	393	584	116.8	==	HILL	140	6	150	416	806	134.3
MORRIS	135	6	141	423	756	126.0	==	JORDON	135	6	143	426	755	125.8
ROTH J	110	6	151	453	794	132.3	==	LIPSON C	110	6	160	456	858	143.0
ROTH G	170	6	171	513	975	162.5	==	LIPSON L	170	6	233	603	1089	181.5
LACEY	180	6	222	666	1188	198.0	==	KALIN	180	6	192	554	1068	178.0
							==							

HIGH SCORES

POS	NAME	AVE	NAME	H-S	NAME	H-G
1	LIPSON C	143	LIPSON C	456	LIPSON C	160
2	HILL	134	ROTH J	453	ROTH J	151
3	ROTH J	132	JORDON	426	HILL	150
1	LACEY	198	LACEY	666	LIPSON L	233
2	LIPSON L	181	LIPSON L	603	LACEY	222
3	KALIN	178	MARTIN	565	BERRA	220

Fig. 1b.

The Software Package

The first program in the bowling package sets up the bowlers' names, averages, sex and status (discussed later), which must be entered on a disk. The programs can handle any combination of up to 210 bowlers playing on as many as 30 teams. To avoid hard-disk error, this information was entered on a disk by writing a nine-line program (excluding data) that uses the bowling information as data statements. Thus, the North Star BASIC edit functions can be used to enter data and execute the program over and over again after it is written until a disk is properly prepared. Listing 1 shows this program.

Variable Z in line 1 represents the teams (1 to 30); Z1 shows the number of players on each team (any number as

```
LANES 5 6        4 WHITE                          1 RED        WEEK # 3

NAME      AVE = 1ST = 2ND = 3RD = TOT = NAME      AVE = 1ST = 2ND = 3RD = TOT
==========================================================================
HILL     -135 =     =     =     =     = HARCOHE -135 =     =     =
--------------------------------------------------------------------------
JORDON   -130 =     =     =     =     = SANDY   -130 =     =     =
--------------------------------------------------------------------------
LIPSON C-143 =     =     =     =     = BROTHMAN-128 =     =     =
--------------------------------------------------------------------------
LIPSON L-181 =     =     =     =     = JOELLY  -165 =     =     =
--------------------------------------------------------------------------
KALIN    -178 =     =     =     =     = SIMMON  -175 =     =     =
--------------------------------------------------------------------------
==========================================================================
--------------------------------------------------------------------------
         TOT.=     =     =     =     =-      TOT.=     =     =     =
--------------------------------------------------------------------------
WON      HAND=     =     =     =     =-WON   HAND=     =     =     =
--------------------------------------------------------------------------
LOST     TOT.=     =     =     =     =-LOST  TOT.=     =     =     =
==========================================================================
```

Fig. 1c.

```
LANES 1 2        1 TIGERS                         2 LIONS      WEEK # 1

NAME      AVE = 1ST = 2ND = 3RD = TOT = NAME      AVE = 1ST = 2ND = 3RD = TOT
==========================================================================
SUE L.   -117 = 106 =  78 =  94 = 278 = ANGELA  -110 = 116 = 114 =  74 = 304
--------------------------------------------------------------------------
MAGGIE S-140 = 128 = 131 = 178 = 437 = RALPH S.-140 = 104 = 121 = 123 = 348
--------------------------------------------------------------------------
FRANK P.-140 = 104 = 153 = 134 = 391 = RENEE L.-125 = 127 = 107 =  99 = 333
--------------------------------------------------------------------------
BILL L. -131 = 132 = 156 = 134 = 422 = JOHN     -123 = 113 ABS = 113 = 113 = 339
--------------------------------------------------------------------------
CHARLIE -144 = 139 = 106 = 128 = 373 = TED R.   -144 = 182 = 178 = 156 = 516
==========================================================================
         672 =     =     =     =     =-      642 = 642 = 633 = 565 =
--------------------------------------------------------------------------
WON   1  HAND=   0 =   0 =   0 =     =-WON   5 HAND=  27 =  27 =  27
--------------------------------------------------------------------------
LOST  5  TOT.= 609 = 624 = 668 =     =-LOST  1 TOT.= 669 = 660 = 592 =
==========================================================================
```

Fig. 4. Filled-in data-entry sheet.

```
FILE :MIX1
DATE :10/03/77
WEEK :2
LANES :1
ON LANE 1 ? 4
ON LANE 2 ? 6
ON LANE 3 ? 2
ON LANE 4 ? 5
ON LANE 5 ? 1
ON LANE 6 ? 3
 4 6 2 5 1 30 TO FIX ? 4
SET ?
```

Fig. 3. Input for program run 1.

Data Entry

The data for this program includes the eight-character team name, followed by eight-character players' names coupled to a five-digit number. Lines 5000 to 5003 of Listing 1 show the data for team 1. The five-digit number corresponds to each bowler's average, sex and status. Therefore, the first bowler in line 5000 is "Sue L," who has a 11710 following her name. The number breaks down as follows: 117—bowling average; 1—sex is female (11700 would be a male with a 117 average); 0—status.

Fig. 2 shows how the above program, "Setup 1," runs. For the first execution, a 1 is entered to clear memory location 30470 to 32767, which will be used for the actual scores. A 0 is entered for the next run and long as the number of players does not exceed 210). Variable Z2 is 2 for a mixed league (both male and female players) or 1 for a league with only one sex participating. Z3 represents the number of games required by a status 0 bowler to establish an average; Z4 applies to a status 1 bowler. This allows the flexibility to require established bowlers to bowl a certain number of games to get a revised average, whereas a different number may be required for new bowlers. Variable Z5 sets the maximum number of pins for an established bowler to lower his average.

Note: Some of these variables are included in the bowling package to handle the more complex average calculations required by a few very sophisticated leagues that compete for high-prize money.

```
0 FOR NEW OR 1 TO CLEAR RAM: 1
READY
RUN

0 FOR NEW OR 1 TO CLEAR RAM: 0
FILE :MIX1
READY
```

Fig. 2. Initialization sequence.

```
FILE: MIX1
TEAM: 1
SUE L.     SCORES   106,78,94    278?
MAGGIE S   SCORES   128,131,178   437?
FRANK P.   SCORES   104,153,134   391?
BILL L.    SCORES   132,156,134   422?
CHARLIE    SCORES   139,106,128   373?
           SCORES   0,0,0      0?
HANDICAP   0,0,0      0?
BLIND      0,0,0      0?
     609      624      668     1901
WON-LOST   1,5  OK
OK TO UPDATE FILE ?
FILE UPDATED
TEAM: 2
ANGELA     SCORES   116,114,74   304?
RALPH S.   SCORES   104,121,123   348?
RENEE L.   SCORES   127,107,99   333?
JOHN       SCORES   0,0,0      0?
TED R.     SCORES   182,178,156   516?
           SCORES   0,0,0      0?
HANDICAP   27,27,27     81?
BLIND      113,113,113   339?
     669      660      592     1921
WON-LOST   5,1  OK
OK TO UPDATE FILE ?
FILE UPDATED
TEAM: 0
READY
```

Fig. 5. Entering data from data-entry sheets (provided by various teams).

the computer asks for a file name. MIX 1 is entered and all the names are written in this disk file.

The main program, called RUN 1 (Listing 2), can now be executed. Fig. 3 shows how this program runs. It asks for the file location of the bowlers' names, the date, the week (1 for first week of bowling, 2 for second, etc.), the league lanes and which team is on each lane. The program prints the lane assignments; an input of 0 lets you change them in case of error. Finally, the program asks "set ?" which allows you to set your paper to line one and push carriage return. Fig. 6 is the printout which follows.

Fig. 3 gives the inputs for week 2. For the first run, you should enter 1 for the week and the computer will generate all blank forms. The blank forms are supplied to the bowling center as input sheets to be used. Fig. 4 shows how this blank form is filled out by the bowlers. The completed form is collected by the center and returned to you for processing.

Listing 3 is the input program —INPUT 1. Fig. 5 shows the data from Fig. 4 being entered into the computer. The program asks for the file name and then the team number. The computer then prints the name of each bowler. Enter the three scores and press return; a total is printed by the computer for verification. This avoids input errors, since the total should agree with the input sheet.

To go to the next bowler push carriage return. Any character except a carriage return will cause the computer to ask for the same bowler's scores again. This allows for the immediate correction of errors.

Note that after Charlie in Fig. 5, scores are still solicited by the computer. This is done because an extra player was put on each team to provide for possible expansion. Next, the computer asks for the handicaps and, finally, for blind scores—scores not actually bowled but assigned to absen-

NYAC MIXED 10/03/77

POS	TEAM		WON	LOST	WIN - LOSS PERCENTAGE	HIGH GAME	HIGH SERIES	AVERAGE	TOTAL WOOD
1	LIONS	(2)	5.0	1.0	.833	669	1921	640.33	1921
2	BEARS	(3)	5.0	1.0	.833	694	1995	665.00	1995
3	ROBBERS	(6)	5.0	1.0	.833	732	2053	684.33	2053
4	TIGERS--	(1)	1.0	5.0	.167	668	1901	633.67	1901
5	LANCERS	(4)	1.0	5.0	.167	693	1974	658.00	1974
6	MAN'TANS	(5)	1.0	5.0	.167	614	1841	613.67	1841

NAME	ENT	#G	H-G	H-S	WOOD	AVE	NAME	ENT	#G	H-G	H-S	WOOD	AVE
	1 TIGERS--							2 LIONS					
SUE L.	117	3	106	278	278	92.7	ANGELA	110	3	116	304	304	101.3
MAGGIE S	140	3	178	437	437	145.7	RALPH S.	140	3	123	348	348	116.0
FRANK P.	140	3	153	391	391	130.3	RENEE L.	125	3	127	333	333	111.0
BILL L.	131	3	156	422	422	140.7	JOHN	123	0	0	0	0	.0
CHARLIE	144	3	139	373	373	124.3	TED R.	144	3	182	516	516	172.0
	0	0	0	0	0	.0		0	0	0	0	0	.0
	3 BEARS							4 LANCERS					
MRS. D	110	0	0	0	0	.0	MRS. H.	110	0	0	0	0	.0
RENEE B.	120	0	0	0	0	.0	NELSON H	140	0	0	0	0	.0
SANDY	106	3	138	347	347	115.7	PAT R.	119	0	0	0	0	.0
BILL D	140	0	0	0	0	.0	ELSIE	110	3	125	286	286	95.3
CHUCK R	154	3	204	496	496	165.3	JOE R.	167	3	226	581	581	193.7
	0	0	0	0	0	.0		0	0	0	0	0	.0
	5 MAN'TANS							6 ROBBERS					
CAROL	103	3	112	291	291	97.0	POLLY	110	3	163	391	391	130.3
EILEEN	120	3	128	307	307	102.3	PAT J.	105	3	128	347	347	115.7
KATHY M.	141	0	0	0	0	.0	JOE W.	111	3	140	356	356	118.7
BLIND	140	0	0	0	0	.0	JOE C.	144	0	0	0	0	.0
PAUL S.	155	3	144	400	400	133.3	RICHIE M	155	3	181	437	437	145.7
	0	0	0	0	0	.0		0	0	0	0	0	.0

HIGH SCORES

POS	NAME	AVE	NAME	H-S	NAME	H-G
1	JOE R.	193	JOE R.	581	JOE R.	226
2	TED R.	172	TED R.	516	CHUCK R	204
3	CHUCK R	165	CHUCK R	496	TED R.	182
1	MAGGIE S	145	MAGGIE S	437	MAGGIE S	178
2	POLLY	130	POLLY	391	POLLY	163
3	PAT J.	115	SANDY	347	SANDY	138

Fig. 6. The finished product.

LANES 5 6 1 TIGERS-- 3 BEARS WEEK # 2

NAME	AVE =	1ST =	2ND =	3RD =	TOT =	NAME	AVE =	1ST =	2ND =	3RD =	TOT
SUE L.	- 92 =				=	MRS. D	-110 =				
MAGGIE S	-145 =				=	RENEE B.	-120 =				
FRANK P.	-130 =				=	SANDY	-115 =				
BILL L.	-140 =				=	BILL D	-140 =				
CHARLIE	-124 =				=	CHUCK R	-165 =				
	- 0 =				=		- 0 =				
	631 =				=-		650 =				
WON	HAND=	17 =	17 =	17 =	=-WON		HAND=	0 =	0 =	0	
LOST	TOT.=				=-LOST		TOT.=				

Fig. 7. Updated data-entry form for distribution to team.

```
290 !TAB(12),%2I,D," ",N1$(V1,V2),TAB(37),"==",TAB(52),%2I,D+1," ",
292 !N1$(V3,V4)
300 FORG=1TOZ1\FORE=0TO1\F=E+D\V1=((F-1)*Z1)+G
310 V2=((V1-1)*6)+B\V4=V1*8\V3=V4-7\V5=EXAM(V2)\V6=EXAM(V2+1)+45
320 Q1=EXAM(V2+2)\Q2=EXAM(V2+3)\GOSUB1000\V7=Q1\V9=INT(A(V1)/100)
325 IFV6=45THENV6=0
330 Q1=EXAM(V2+4)\Q2=EXAM(V2+5)\GOSUB1000\V8=0\IFV5<1THEN340
335 V8=Q1/V5
340 !N$(V3,V4),%4I,V9,V5,V6,V7,%6I,Q1,%6F1,V8,\GOSUB1300
345 GOSUB1460
350 IFE=0THEN!"  == ",\NEXT\!""\NEXT\!TAB(37),"==="\L=L+L1
360 IF64>L+L1THEN380
370 E=66-L\FORG=1TOL\!""\NEXT\GOSUB1110\L=4
380 NEXT\L=L+2\!""\!""\IFL<56THEN390
385 L=66-L\FORB=1TOL\!""\NEXT\L=0
390 !"HIGH SCORES"\!"POS NAME          AVE   NAME          H-S   ",
392 !"NAME          H-G"
400 GOSUB1040\FORE=0TOZ2-1\FORF=0TO2\!%2I,F+1,"  ",\FORD=0TO2\GOSUB1400
410 !N$(V1,V2),%7I,INT(V3),"    ",\NEXT\!""\NEXT\!""\NEXT
500 L=L+6\IFZ2>0THENL=L+4
510 FORY=1TO66\!""\NEXT
600 FORD=1TOZSTEP2\Q1=P(2,D)\Q3=P(2,D+1)\Q2=Q1*8\Q4=Q3*8
602 GOSUB1630
605 !"LANES",Z7,Z7+1,TAB(15),%2I,Q1," ",N1$(Q2-7,Q2),\Z7=Z7+2
610 !TAB(54),%2I,Q3," ",N1$(Q4-7,Q4),TAB(67),"WEEK #",%3I,Z6\!""
620 !"NAME      AVE = 1ST = 2ND = 3RD = TOT = ",
630 !"NAME      AVE = 1ST = 2ND = 3RD = TOT"
640 GOSUB1040\FORF=1TOZ1\FORG=0TO1\V1=Q1\IFG>0THENV1=Q3
670 V2=((V1-1)*Z1)+F\V3=V2*8
675 K(G)=K(G)+A(V2)
680 !N$(V3-7,V3),"-",%3I,A(V2),"  =      =      =",
690 IFG>0THEN700\!"      = ",\GOTO710
700 !""
710 NEXT\GOSUB1600\NEXT\GOSUB1040
712 IFK(0)>K(1)THEN716
713 K(2)=INT((K(1)-K(0))*.9)\K(3)=0\GOTO718
716 K(3)=INT((K(0)-K(1))*.9)\K(2)=0
718 !%12I,K(0)," ",\B$="  "\GOSUB1700\!%12I,K(1)," ",\GOSUB1710
720 GOSUB1630\GOSUB1600\!"WON      HAND=",%4I,K(2),"  =",
722 !%4I,K(2)," =",%4I,K(2)," =      =--",
724                          !"WON      HAND=",%4I,K(3),"  =",
728 !%4I,K(3)," =",%4I,K(3)," "
740 GOSUB1600\A$="LOST      TOT."\B$="      "\GOSUB1600\GOSUB1040
742 K(0)=0\K(1)=0
750 !"\!""
760 IFD<3THEN800\FORY9=1TO10\!""\NEXT
800 NEXT\END
999 !FREE(0)\END
1000 Q1=(Q2*256)+Q1\RETURN
1040 FORY=1TO76\!"=",\NEXT\!""\RETURN
1110 !"\!""\!"NAME      ENT  #G H-G H-S  WOOD   AVE  == ",
1120 !"NAME      ENT  #G H-G H-S  WOOD   AVE"\GOSUB1040\RETURN
1300 P(0,0)=V8*10\P(0,1)=V7*10\P(0,2)=V6*10
1310 Q3=INT((A(V1)-(V9*100))/10)\FORQ1=0TO2\FORQ2=0TO2
1320 IFP(0,Q1)<(H(Q3,Q1,Q2)/1000)THEN1350
1330 IFQ2>1THEN1340\FORV2=2TOQ2+1STEP-1\H(Q3,Q1,V2)=H(Q3,Q1,V2-1)\NEXT
1340 H(Q3,Q1,Q2)=(INT(P(0,Q1))*1000)+V1\EXIT1360
1350 NEXT
1360 NEXT\RETURN
1400 V3=INT(H(E,D,F)/1000)\V1=H(E,D,F)-(V3*1000)
1410 V2=V1*8\V1=V2-7\V3=V3*.1\RETURN
1460 Q4=A(V1)-(V9*100)-(Q3*10)\Q2=Z2
1470 IFQ4>0THENQ2=Z3\IFV5=>Q2THEN1490
1480 A(V1)=V9\RETURN
1490 V5=INT(V8)\IFV5+Z5>V9THEN1510
1500 A(V1)=V9-5\RETURN
1510 A(V1)=V5\RETURN
```

tee players.

Fig. 4 shows John is absent; ABS was entered next to his scores, all of which are ten pins less than his average (blind scores). In Fig. 5, John's scores are not entered next to his name but are entered as blind. The computer prints the point totals to be compared and then asks for the won and lost points, which are supplied by the bowlers on the input sheet.

A carriage return after OK TO UPDATE FILE? enters the data; anything else erases all the input. A carriage return signifies your approval of each individual input line; anything else allows for the re-input of the line. Team 0 ends the input program. All input need not be done at the same time. However, before the machine is turned off the scores must be saved by copying memory locations 30470 to 32767 to a file. With the North Star Disk System, this is done by:

```
BYE
SF DATA1 7706
```

This assumes file DATA 1 was created. The 7706 is hex for the start of the memory locations to be saved.

Fig. 6 shows the finished product generated by program RUN 1 (Listing 2). Fig. 3 describes the input required for this run. Fig. 7 shows a new blank input form generated by RUN 1. The averages have been updated; a comparison of Team 1's averages to those shown in Fig. 4 illustrates how they've changed. A spelling correction and team names were also added by editing program SETUP 1 and running it again.

Fig. 8 shows the table of contents for my bowling package disk—three copies of each program and two of the data. In this figure, North Star BASIC is referred to as B. My system has 24K placed in addresses 8192 to 32767. Address 2A0A (hex) was changed to 76 (hex) to use addresses 30470 to 32767 for fill and examine instructions. Therefore, GO B and Print Free (0) yield 9105 bytes.

Wrap-up

Good luck with this application. Just remember to concentrate on marketing and maybe add some new features to these programs to attain an edge. I have several leagues enrolled now and plan to improve my service. Maybe we will be in competition.■

```
BYE
*LI
DOS          4   10    0
B           14   40    1 2A00
SETUP1      54   24    2
SETUP2      78   24    2
SETUP3     102   24    2
INPUT1     126   24    2
INPUT2     150   24    2
INPUT3     174   24    2
RUN1       198   24    2
RUN2       222   24    2
RUN3       246   24    2
DATA1      300   10    3
DATA2      270   10    3
MIX1       280   10    3
MIX2       290   10    3
*SF DATA1 7706
*SF DATA2 7706
*GO B

READY
PRINT FREE(0)
 9105
READY
```

Fig. 8. Bowling-package directory.

Listing 1. Initial data-base generation.

```
1 Z=6\Z1=6\Z2 =2\Z3=3\Z4=0\Z5=0
3 INPUT"O FOR NEW OR 1 TO CLEAR RAM: ";A\IFA=1THEN200
5 IFA<>0THENEND\INPUT"FILE :";F$\OPEN#0,F$
10 DIMA$(8)
15 A$=""
20 WRITE#0,Z,Z1,Z2,Z3,Z4,Z5
110 FORA=1TOZ\READA$\WRITE#0,A$\FORB=1TOZ1\READA$\,C
120 WRITE#0,A$,C\NEXT\NEXT
```

```
130 CLOSE#0\END
200 FORA=30470TO32767\FILLA,B\NEXT\END
5000 DATA"---------","SUE L.  ",11710,"MAGGIE S",14010,"FRANK P.",14000
5002 DATA"BILL L. ",13100,"CHARLIE ",14400
5003 DATA"         ",00000
5004 DATA"---------","ANGELA  ",11010,"RALPH S.",14000,"RENEE L.",12510
5006 DATA"JOHN     ",12300,"TED R.  ",14400
5007 DATA"         ",00000
5008 DATA"---------","MRS. D  ",11010,"RENEE B.",12010,"SANDY   ",10610
5010 DATA"BILL D   ",14000,"CHUCK R ",15400
5011 DATA"         ",00000
5012 DATA"---------","MRS. H. ",11010,"NELSON H",14000,"PAT R.  ",11910
5014 DATA"ELSIE    ",11010,"JOE R.  ",16700
5015 DATA"         ",00000
5016 DATA"MAN'TANS","CAROL   ",10310,"EILEEN  ",12010,"KATHY M.",14110
5018 DATA"BLIND    ",14000,"PAUL S. ",15500
5019 DATA"         ",00000
5020 DATA"---------","BLIND   ",11010,"PAT J.  ",10510,"JOE W.  ",11100
5022 DATA"JOE C.   ",14400,"RIICHIE M",15500
5023 DATA"         ",00000
READY
```

Listing 2. The main program (called RUN 1).

```
1 DIMN1$(240),N$(1680),P(2,30),H(1,2,2),N2$(8),A(210),A$(20)
3 LINE 80
5 INPUT"FILE :",F$\OPEN$0,F$
6 READ$0,Z,Z1,Z2,Z3,Z4,Z5\FORA=1TOZ\READ$0,N2$\V2=A*8
8 N1$(V2-7,V2)=N2$\FORB=1TOZ1\READ$0,N2$,C\D=((A-1)*Z1)+B
10 V2=8*D\N$(V2-7,V2)=N2$\A(D)=C\NEXT\NEXT
12 A$="                    "
14 B$="------"\C$="="
15 A$(1,10)="NYAC MIXED"   \INPUT"DATE :",A$(11,20)\INPUT"WEEK :",Z6
16 INPUT"LANES :",Z7
17 FORD=1TOZ\!"ON LANE",D,\INPUT" ? ",P(2,D)\NEXT
18 FORD=1TOZ\!P(2,D),\NEXT\INPUT"0 TO FIX ? ",E\IFE=0THEN17
20 A=30470\B=30800\C=32060
30 FORD=1TOZ\P(0,D)=D\Q1=A+(11*(D-1))\Q2=EXAM(Q1+1)\Q1=EXAM(Q1)
40 GOSUB1000\P(1,D)=Q1\NEXT
50 Q1=0\FORD=2TOZ\IFP(1,D-1)>=P(1,D)THEN80
60 Q2=P(1,D-1)\Q3=P(0,D-1)\P(1,D-1)=P(1,D)\P(0,D-1)=P(0,D)
70 P(1,D)=Q2\P(0,D)=Q3\Q1=10
80 NEXT\IFQ1>0THEN50
95 G=(Z6-1)*3\INPUT"SET ?",Z$
100 !TAB(30),A$(1,10),TAB(60),A$(11,20)\!TAB(30),"==========="\!""
138 !TAB(33),"WIN - LOSS  HIGH   HIGH                TOTAL"
140 !"POS TEAM             WON   LOST  PERCENTAGE  GAME  SERIES",
150 !"  AVERAGE      WOOD"\GOSUB1040
170 FORD=1TOZ\E=P(0,D)\V2=8*E\V1=V2-7\V3=2+A+((E-1)*11)\Q1=EXAM(V3)
180 Q2=EXAM(V3+1)\GOSUB1000\V4=Q1\IFP(1,D)+V4<1THEN190
185 V5=P(1,D)/(P(1,D)+V4)
190 Q1=EXAM(V3+2)\Q2=EXAM(V3+3)\GOSUB1000\V6=Q1
200 Q1=EXAM(V3+4)\Q2=EXAM(V3+5)\GOSUB1000\V7=Q1
210 Q1=EXAM(V3+6)\Q2=EXAM(V3+7)\Q3=EXAM(V3+8)\GOSUB1000
215 IFQ3ORG=0THEN225
220 V9=Q1+(Q3*65536)\V8=V9/G
225 P(1,D)=P(1,D)*.1\V4=V4*.1
230 !%3I,D," ",N1$(V1,V2)," (",%2I,E,")",%7F1,P(1,D),
240 !%7F1,V4,%9F3,V5,"   ",%6I,V6,%8I,V7,%9F2,V8,%10I,V9
250 NEXT\L=6+Z\IF64>L+4+1+Z1THEN270
260 D=66-L\FORE=1TOD\!""\NEXT\L=0
270 GOSUB1110\L=4\L1=2+Z1
280 FORD=1TOZSTEP2\V2=D*8\V1=V2-7\V3=V1+8\V4=V2+8
1600 !A$,C$,B$,C$,B$,C$,B$,C$,B$,C$,"-",
1610 !A$,C$,B$,C$,B$,C$,B$,C$,B$\RETURN
1620 RETURN
1630 A$="------------"\B$="------"\RETURN
1700 !   C$,B$,C$,B$,C$,B$,C$,B$,C$,"-",
1705 RETURN
1710 !   C$,B$,C$,B$,C$,B$,C$,B$\RETURN
READY
```

Listing 3. The data-entry program.

```
10 DIMN$(1680),A$(8),S(10,6)
15 F1=30470\F2=30800
20 INPUT"FILE: ",F$\OPEN$0,F$
30 READ$0,Z,Z1,Z2,Z3,Z4,Z5\W=Z1+2
40 FORA=1TOZ\READ$0,A$\FORB=1TOZ1\READ$0,A$,C
50 D=((A-1)*Z1)+B\D=D*8\N$(D-7,D)=A$\NEXT\NEXT
55 FORA=0TOW\FORB=0TO5\S(A,B)=0\NEXT\NEXT
60 INPUT"TEAM: ",A\FORB=1TOZ1\D=((A-1)*Z1)+B
65 IFA<1ORA>ZTHENEND\D=D*8
70 !N$(D-7,D),\INPUT1"  SCORES  ",S(B,1),S(B,2),S(B,3)
75 S(B,4)=S(B,1)+S(B,2)+S(B,3)
80 !%6I,S(B,4),\INPUTZ$\IFZ$=""THEN90\GOTO70
90 NEXT
100 INPUT1"HANDICAP  ",S(W,1),S(W,2),S(W,3)\S(W,4)=S(W,1)+S(W,2)+S(W,3)
110 !%6I,S(W,4),\INPUTZ$\IFZ$=""THEN112\GOTO100
112 INPUT1"BLIND     ",S(W-1,1),S(W-1,2),S(W-1,3)
114 S(W-1,4)=S(W-1,1)+S(W-1,2)+S(W-1,3)
116 !%6I,S(W-1,4),\INPUTZ$\IFZ$=""THEN120\GOTO112
120 FORB=1TOW\FORC=1TO4\S(0,C)=S(0,C)+S(B,C)
125 IFC=4THEN150
130 IFS(B,C)>0THENS(B,0)=S(B,0)+1
140 IFS(B,C)>S(B,5)THENS(B,5)=S(B,C)
150 NEXT\NEXT
152 FORB=1TO3\IFS(0,B)>S(0,5)THENS(0,5)=S(0,B)\NEXT
160 FORC=1TO4\!%8I,S(0,C),\NEXT\!""
162 INPUT1"WON-LOST  ",W1,W2\INPUT"  OK",Z$
164 IFZ$=""THEN170\GOTO162
170 INPUT"OK TO UPDATE FILE ?",Z$\IFZ$=""THEN180\GOTO55
180 S(0,0)=W1*10\S(0,2)=W2*10\S(0,6)=S(0,4)\S(0,4)=S(0,5)
190 F3=F1+((A-1)*11)\FORB=0TO6STEP2\C=F3+B\D=F3+B+1
200 L=EXAM(C)\M=EXAM(D)\GOSUB1000
210 IFB>3THEN250
220 N=N+S(0,B)\GOSUB2000\FILLC,L\FILLD,M\GOTO300
250 IFN>S(0,B)THEN300\N=S(0,B)\GOSUB2000
260 FILLC,L\FILLD,M
300 NEXT
310 L=EXAM(F3+8)\M=EXAM(F3+9)\O=EXAM(F3+10)\GOSUB1000
320 N=N+(65536*O)+S(0,6)\O=INT(N/65536)
330 N=N-(O*65536)\GOSUB2000
340 FILLF3+8,L\FILLF3+9,M\FILLF3+10,O
400 F3=((A-1)*Z1*6)+F2\FORB=1TOZ1\F4=((B-1)*6)+F3
410 L=EXAM(F4)\L=L+S(B,0)\FILLF4,L\N=S(B,5)-45
420 L=EXAM(F4+1)\IFL>NTHEN430\FILLF4+1,N
430 L=EXAM(F4+2)\M=EXAM(F4+3)\GOSUB1000
440 IFN>S(B,4)THEN460\N=S(B,4)\GOSUB2000
450 FILLF4+2,L\FILLF4+3,M
460 L=EXAM(F4+4)\M=EXAM(F4+5)\GOSUB1000\N=N+S(B,4)
470 GOSUB2000\FILLF4+4,L\FILLF4+5,M
480 NEXT\!"FILE UPDATED"\GOTO55
1000 N=L+(256*M)\RETURN
2000 M=INT(N/256)\L=N-(256*M)\RETURN
READY
```

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It's Here: Machine Language for the TRS-80

A description of a new monitor program from Radio Shack for the TRS-80.

Tired of playing blackjack with your TRS-80? Want to get down to serious business? If so, you've probably found that Radio Shack's 4K BASIC keeps you insulated from most of the Z-80's impressive capabilities. Wouldn't it be nice if there were some way to get out of BASIC and into the guts of the machine? Well, there is!

Radio Shack is now offering T-BUG, a 1K monitor program that permits you to use your TRS-80 as a *limited* development system. I have been playing with a copy for about a month now, and can report that it adds a whole new dimension to the usefulness of the machine.

Though I say limited, there is really no limit to what you can do with enough perseverance. However, it is only a 1K monitor, and as such, is roughly comparable to the 6800 MIKBUG, or similar programs. I wouldn't want to develop a compiler with it, but it does open all kinds of doors most of us thought were closed.

T-BUG comes on a cassette and loads like any ordinary tape, using CLOAD. There's one profound difference—when the tape load is finished, you don't get the expected READY. Instead, you get a #, which tells you that you're free from BASIC!

How does this happen? As near as I can tell, each tape has a leader block, which not only contains the usual information, such as the load address and length of record, but also the address at which execution is to begin. For all tapes generated by BASIC, this address is 0000, and thus has the same effect as a reset. On the T-BUG tape, the address is the first instruction of T-BUG, which gets you going.

Now, without going any further into the details of the monitor, we already have some intriguing possibilities—such as writing our own tapes with custom operating systems for special uses, or building a black box which simulates the input of that leader data.

I suppose I knew that there had to be some kind of system like this . . . how else could Radio Shack provide the assembler/editor tapes? Still, it's nice to know how to do it yourself. No, you can't write tapes with your own start address from T-BUG . . . it always starts at its own entry; but now you can get into the machine and make it do things your way!

Note that the CRT display occupies address space. The CRT video generation is totally transparent to the CPU. Just store an ASCII character in a location, and it's displayed. Incidentally, the arrows on the four cursor control keys are displayable as codes 5B through 5E. 5F is the cursor (_).

Note also that the keyboard occupies 256 bytes of address space, and a lot more if you count the unused space around it. This may seem wasteful, but, in my opinion, is the cleverest feature of the whole computer. We have all seen systems with a matrix-type keyboard. Typically, you put out an 8-bit word to an output port, which is latched and strobes the rows of the matrix. The columns are then read into an input port.

Radio Shack has reduced this concept to its bare essentials: There are no ports . . . the keyboard ties right across the

M nnnn	Displays the contents of location nnnn in hex. If you wish to alter the contents, merely enter the new data. The monitor will then display the next location, etc. To skip to the next location without entering new data, press ENTER.
X	Gets you out of the M mode. It also is used to abort other commands, such as when you type the wrong value for an address.
B nnnn	Sets a breakpoint at location nnnn. When control reaches this location, it will revert back to the monitor. The manual says only one breakpoint can be set at once. This is not strictly true . . . you can set as many as you want, but the monitor will only remember the last one.
F	Removes a previously set breakpoint. This is where the remembering comes in!
R	Displays the contents of the registers. All registers, including the program counter, stack pointer and index registers are displayed. The contents of these registers cannot be altered directly using R. However, it can be done if you need to.
P nnnn mmmm	Writes the contents of locations nnnn through mmmm to the cassette.
L	Loads a program from cassette. The program loads into the same locations it was written from.

When I got my copy of T-BUG, the first thing I set out to do was to explore the memory space of the computer. As a result, I was able to draw the memory map shown below:

0000-0FFF	4K BASIC monitor.
1000-2FFF	Empty ROM sockets for remaining 8K.
2000-37FF	Unused. (Usable???)
3800-3880	Keyboard.
3881-3BFF	Unused.
3C00-3FFF	CRT display RAM.
4000-7FFF	User RAM.
8000-FFFF	Expansion.

Table 1. T-BUG instructions.

address and data lines. When the keyboard is enabled by a high byte of 38, the low byte serves to strobe the matrix. Only one line of this byte can be high at one time, which explains why the keyboard takes up so much room. Only the addresses 3801, 3802, 3804, 3808, 3810, 3820, 3840 and 3880 are actually used.

Now, here's the great part: When an address line is high and a key in that row is depressed, the key ties the address and data lines together! This drives a data line high, and it is read as a byte with one high bit. In other words, to the CPU, the keyboard looks just like any other RAM. In this case, there is a considerable software overhead for decoding.

Low Addr →		01	02	04	08	10	20	40	80
Data	01	@	H	P	X	0	8	cr	shft
↓	02	A	I	Q	Y	1	9	clr	
	04	B	J	R	Z	2	:	brk	
	08	C	K	S		3	;	↑	
	10	D	L	T		4	,	↓	
	20	E	M	U		5	-	←	
	40	F	N	V		6	.	→	
	80	G	O	W		7	/	ъ	

Fig. 1. Keyboard organization.

However, RS wisely made the right choices as to where to allocate software and hardware—use software where speed is not an issue (keyboard) and hardware where it is (CRT). The organization of the keyboard is laid out in Fig. 1.

There are a few noteworthy points about this organization. First, the keys are essentially sequential in their ASCII order, so decoding is reasonably straightforward. Second, the shift key is in a column by itself, so it can be used with any other key. I repeat . . . *any* other key, so if you wish you had not only lowercase, but also more special keys, you can get them. Would you believe shift-space bar? Finally, if you *really* want them, there's room in the matrix, if not on the keyboard, for five more keys.

As you can see, I've been having a lot of fun with T-BUG so far; and I've hardly begun to write software! It is a fairly limited monitor, in keeping with its size. If I had written it, I probably would have done things a little differently. And since I now have the capability, that's what I'm doing! ■

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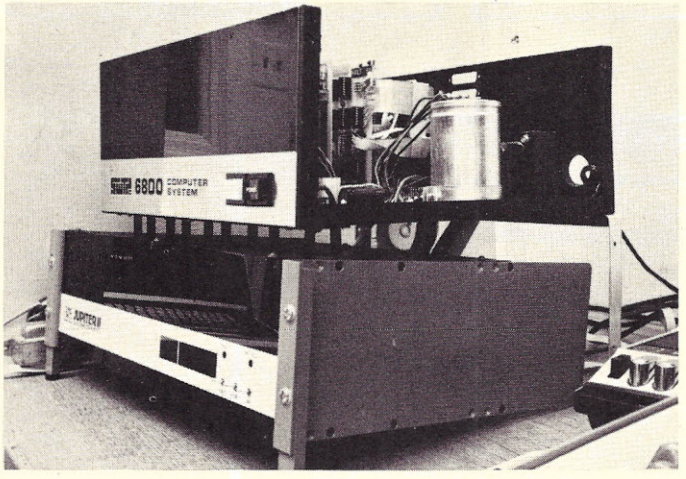
Two Systems Sharing the Same Bus

Distributed computing comes to microcomputers with this clever I/O system.

I believe this article is a first in computer-hobbyist publications. I don't recall ever seeing an article on interfacing two microcomputers. The technique is rather widespread in the world of the mainframes . . . but I suspect Mark is only one of a handful of people who have done it with personal systems. —John.

Many computer hobbyists have experienced (or will someday) the ultimate frustration: a full bus. To the experimenter (with good financing) who delights in adding new gadgets to his computer system, a full bus means that new boards can no longer be plugged in with impunity. Now a decision must be made. Which old board will be removed to make room for the latest board?

One alternative to this horrible situation is to buy a new computer for the new boards. Of course, all those neat boards in the old computer can't be used in both computers simultaneously, and a great deal of duplication becomes necessary. A better alternative is to expand the bus of the original computer onto a second bus with its own cabinet, power supply, etc. This solution allows simultaneous use of all the boards, but it is almost as expensive as buying a second computer.



My two-computer system. The SWTP part of the interface can be seen in the last SWTP slot. The two interface cables run from this board, through separate openings in the back panel, down to the WM part of the interface.

Why not have the best of both alternatives? Extend your computer's bus by interfacing it to another microcomputer! This really isn't as difficult as it sounds, and it gives you the choice of either two independent computers or one larger computer. The two computers don't even have to be the same type, although things get more complicated with different CPUs. This article describes an interface between two different microcomputers that use the Motorola 6800 CPU, but the same basic ideas could be used to interface any two microcomputers.

Overview

I interfaced my two computers in an arrangement that allows either fully independent operation or master-slave operation. In the master-slave mode, the master computer takes over the slave-computer's bus and uses the slave's memory and I/O just as if they were on the master's bus. The mode of operation is under software control by the master computer.

My master computer is a Wave Mate Jupiter II. This is a nicely designed and executed system with many useful features. My expansion bus (the slave microcomputer), which doesn't need all the features of the master computer, is an SWTP 6800. Since both computers employ the 6800 CPU chip, much of the software I use with the Wave Mate (WM) can be modified to run on the SWTP. Moreover, the interface between two buses designed for the same CPU chip is only slightly more complicated than an interface between two identical buses.

The SWTP is almost ideal as a slave microcomputer—it is inexpensive, has a wide range of I/O available and is simple and easy to modify for DMA (di-

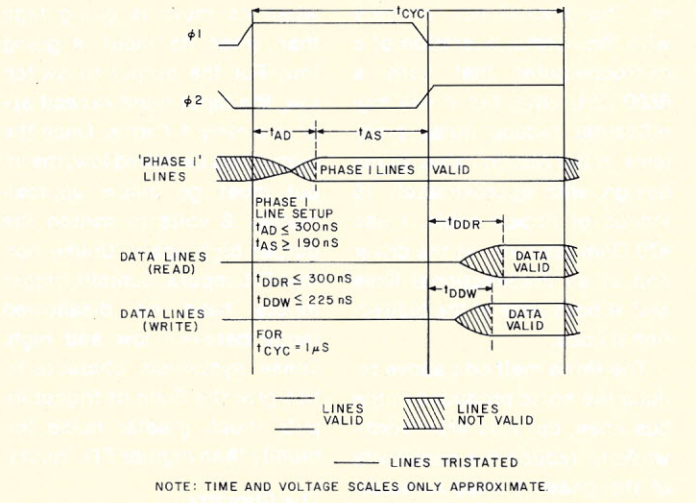


Fig. 1. Timing diagram for the M6800 microprocessor (from Motorola's M6800 Microcomputer System Design Data*).*

rect memory access) by halting. (The required modification will be covered later in this article.)

Since both microcomputers use the same CPU, the same basic signals must be used on both buses. While the WM uses a 72-line bus and the SWTP uses a 50-line bus, only 29 lines on the SWTP bus must be controlled by a DMA device. I used 33 distinct connections, including the ground connection, between the two computers.

Interface Considerations

Before we get into the specific interface design, let's consider how to get the bus signals between the two computers. Overcoming this problem, which is present in any bus extension, is probably the most critical part of the interface design.

Suppose you need to interface two identical motherboards. Why not use a ribbon cable to connect the buses line for line? This seems to be a simple, inexpensive way to extend the bus. Unfortunately, unless the cable is very short, it will not work.

The wires in a ribbon cable are too close together and have too little surface area to use as a computer bus. As a result, the signals on one line will induce noise on the other lines. The faster the signals on the lines change state, the larger the current flow in the lines, and the longer the lines, the greater the induced noise problems. If the noise is enough to change the logic levels on some of the lines, chaos results.

The 6800 CPU synchronizes the changes in level of the address lines, VMA (valid memory address) and R/W (read/write) with the phase 1 clock signal. All these lines may change state only during the first part of the machine cycle. The data lines are synchronized with the phase 2 clock signal. They change state during the second part of the machine cycle. See Fig. 1 for a diagram of these timing relationships.

The noise induced by the changes in the lines synced by the phase 1 clock is not likely to interfere with normal computer operation. Fig. 1 shows the signals on the lines synced by phase 1 are not valid when these changes occur, and the data lines, synced by phase 2, are in a high-impedance state. Unless the noise pulses cause ringing in the lines or are large enough to damage the ICs attached to the lines, they will not upset the operation of the computer.

When the data lines change state, noise may be induced on the lines synced by the phase 1 clock. The signals on these (control and address) lines must be valid during the last part of phase 1 and all of phase 2. Since the data lines change state during the first part of phase 2, noise may be induced on the phase 1 lines at a time when they must be valid. If they're large enough, these noise pulses can really mess up the computer's operation.

The Ribbon Cable

Several approaches can be used to minimize noise between the lines of the ribbon cable. Because noise problems can be extremely difficult to track down and fix in an existing design, I used an overkill approach, involving three different methods to minimize the noise in the ribbon cable.

1. Since the induced noise falls off rapidly as the conductors are moved apart, I separated the data lines from the other bus lines. I used two cables to carry the signals between the computers with spacers to keep them apart. A 26-conductor ribbon cable carries all of the phase 1 synced signals and a 16-conductor ribbon cable carries the data lines.

2. I partially shielded the data lines by alternating them with ground lines in the 16-conductor cable. This cuts down on the amount of noise radiated by these lines. These eight ground lines are the only ground connections between the computers. This probably would not work if the ribbon cable had to carry the actual bus signals, but, as we shall see, it does not.

3. I used drivers and receivers on all lines running between the two computers, except for the ground lines and one line used to initialize the halt control circuitry. This means that the ribbon cable does not need to carry much current, and that the current-limiting resistors can be used to limit the rate of change of the signals on the cable. It also means that the ground connection between the computers carries little current.

The ribbon cable conductors look, to the drivers, like a complicated network of capacitance, inductance and resistance. To change a line from its low level to its high level, its

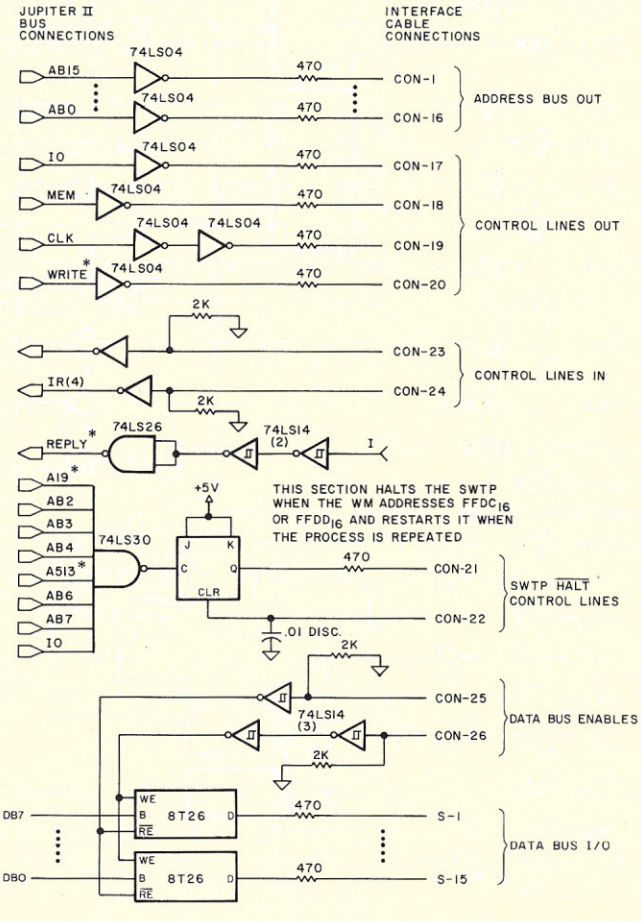


Fig. 2. Wave Mate Jupiter II to SWTP 6800 interface: WM section.

equivalent capacitance must be charged by the driver. To change it from high to low, this same capacitance must be discharged. The resistance and inductance in the line, as well as the output current capabilities of the driver, determine the rate at which the line can be charged or discharged. For high-current drivers (e.g., 8T26s), and moderate lengths of cable, the time constant for charging or discharging a line is a few nanoseconds (ns) or less.

Microcomputer bus lines do not need to change state in ns. Typical allowed setup times for bus lines on the 6800, using a 1 MHz clock, are 150 to 200 ns. Since noise problems increase with increasing rates of change on the bus lines, it makes sense to slow the lines down to the rate needed by the computer system.

Current-limiting resistors can be connected between the drivers and ribbon-cable conductors to limit the rate lines can be charged or discharged. The receivers I used require less than .2 mA of current flow in the ribbon cable for proper switching. This means that if a .5 volt drop is the maximum allowed across the resistor, the resistor could be as large as 2.5k.

Since typical ribbon cable has an interwire capacitance of 10 to 20 pF per foot, the capacitance seen by the drivers will be on the order of 20 pF. A 1k resistor in series with a 20 pF capacitor will allow the capacitor to charge to 98 percent of any voltage applied across the combination in less than 100 ns. This should not interfere with the normal operation of a microcomputer that uses a 6800 CPU chip, but it will significantly reduce noise problems in the ribbon cable. In my design, with approximately 18 inches of ribbon cable, I use 470 Ohm resistors at the driver end of all unidirectional lines and at both ends of the bidirectional lines.

The three methods above reduce the noise produced in the bus lines, but it is also worthwhile to reduce the sensitivity of the phase 1 lines to noise. Since we are using a driver-receiver scheme, we can use receivers that have a high noise immunity. TTL Schmitt trigger input inverters are ideal for this purpose.

The TTL Scmitt trigger has a different switching threshold when its input is going high than when its input is going low. For the output to switch low, the input must exceed approximately 1.7 volts. Once the output has switched low, the input must go below approximately .8 volts to switch the output high again. Unlike normal TTL inputs, Schmitt trigger inputs have no disallowed range between low and high. These hysteresis characteristics give the Schmitt trigger inputs much greater noise immunity than regular TTL inputs.

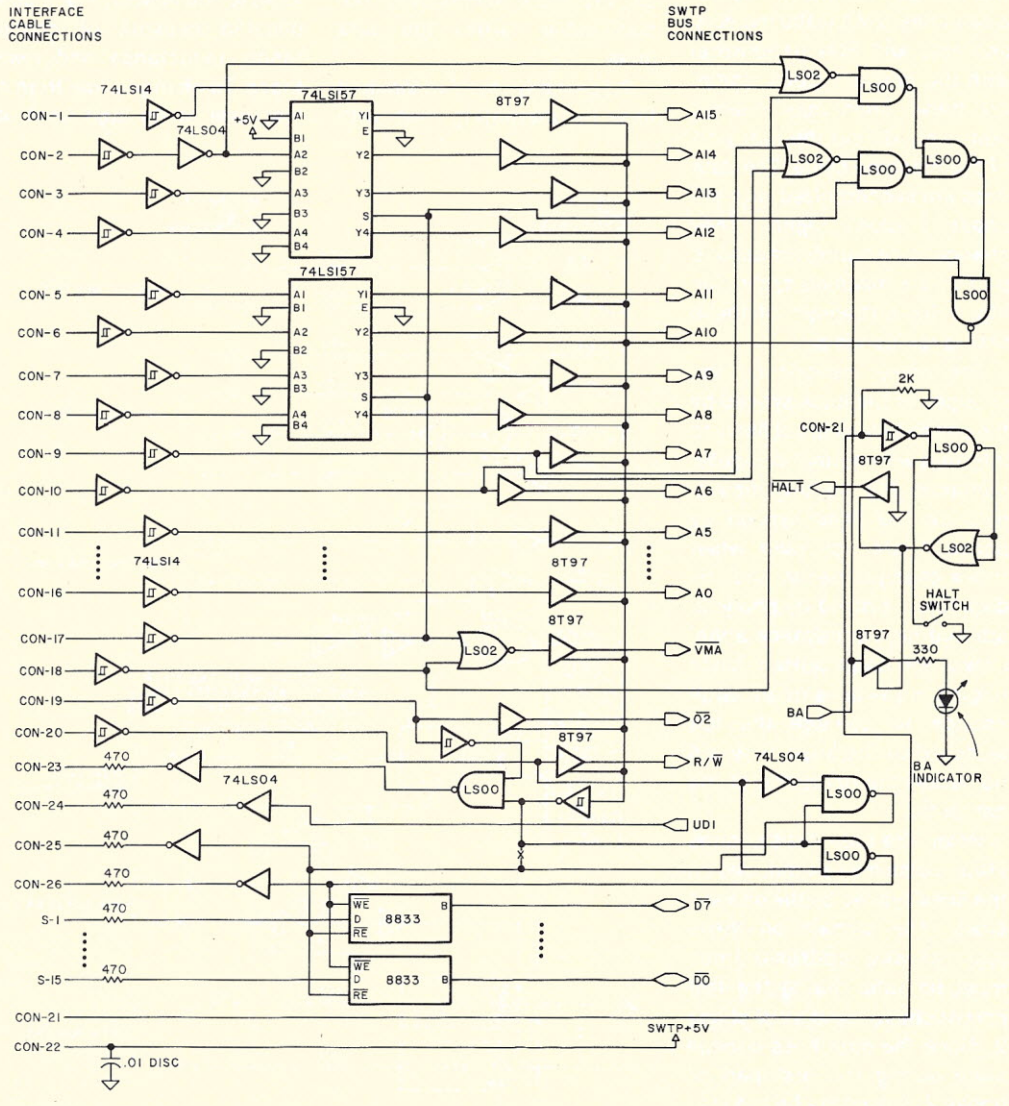


Fig. 3. Wave Mate Jupiter II to SWTP 6800 interface: SWTP section.

The Circuitry

Now let's look at the Wave Mate to SWTP interface design. The schematics for the two parts of the interface are given in Figs. 2 and 3. Fig. 2 shows the logic located in the WM and Fig. 3 illustrates the logic in the SWTP. The two connecting cables are denoted by Con (the 26-conductor cable) and S (the 16-conductor cable). I haven't shown the ground connections (every even-numbered line in S) or the repeated circuitry in the address lines and data lines.

Most of the logic to convert the WM bus signals to the SWTP bus signals is located in the SWTP. This is because only half of a WM board was available for use in the interface. In any case, it makes sense to put as much interface as possible in the slave computer where it will use power only when the slave is in use.

In addition to reducing noise problems, the driver, current-limiting resistor, receiver design also allows simple circuitry for independent use of the computers. When one computer is unpowered, the current-limiting resistors prevent excessive current flow from the drivers in the other computer. For fully independent operation of the two computers with the interface, 2k pull-down resistors were installed on four of the 74LS14 inputs on the WM board and one on the SWTP board. These resistors prevent the interface from interfering with the operation of either computer when the other computer is not powered or the interconnecting cables are dis-

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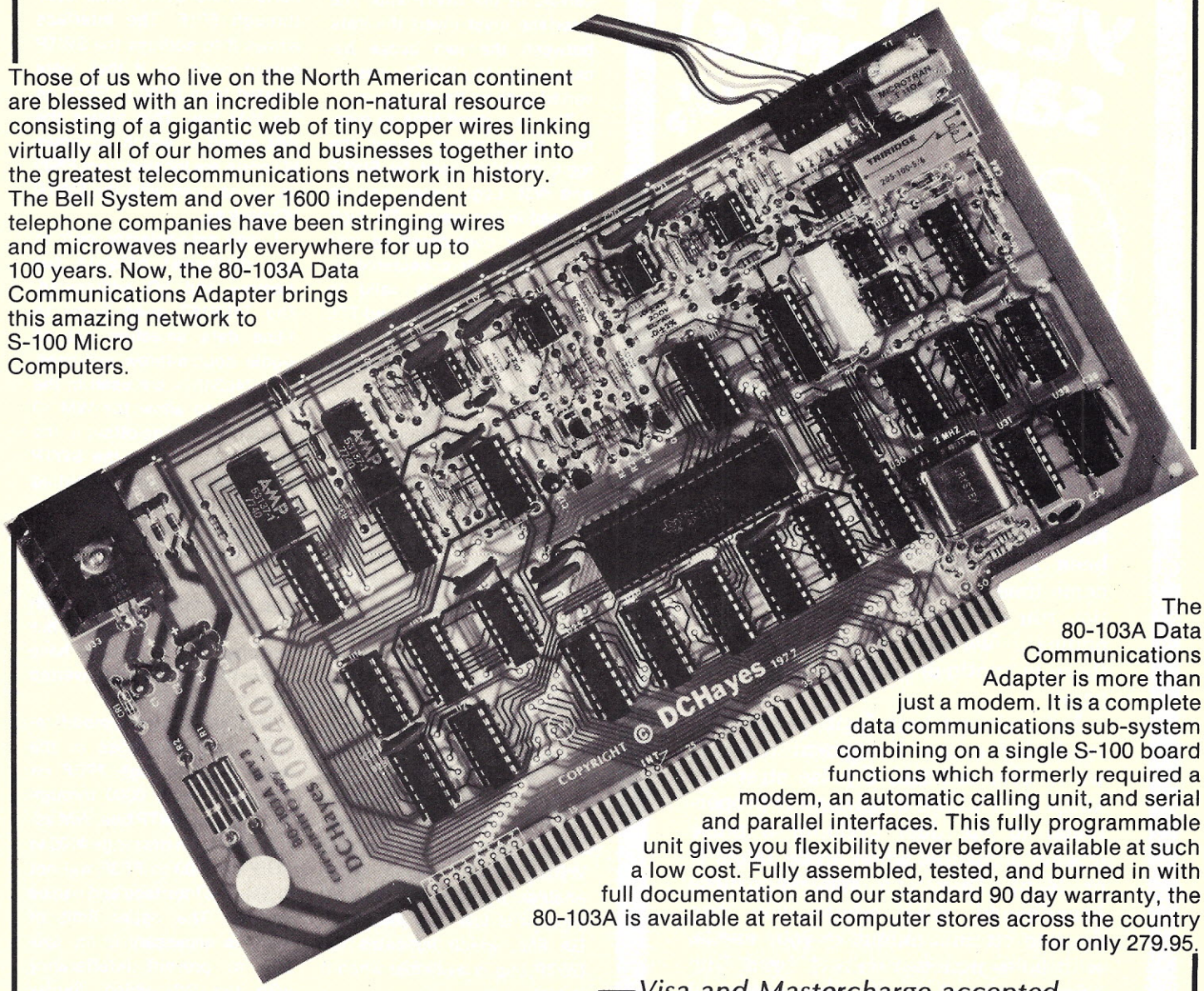

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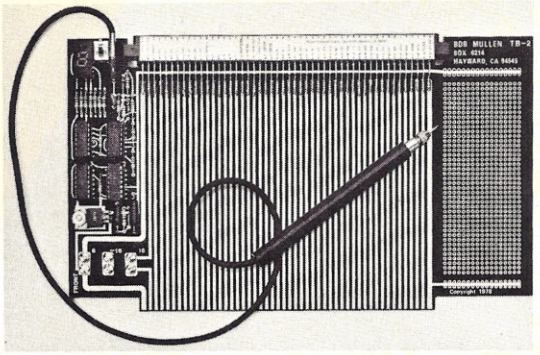

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connected.

The interface uses 26 unidirectional lines to carry information from one computer to the other. Twenty-one are used to supply information to the SWTP. The other five lines carry information to the WM from the SWTP. We will discuss these lines in more detail later.

The bidirectional lines (data lines) use 8T26 inverting bus transceivers at the WM end and 8833 noninverting bus transceivers at the SWTP end. The interface must invert the data between the two buses because only the SWTP uses inverted data on its main bus.

This is a good time to mention some points about the logic notation used by SWTP and WM. Logic levels can be defined in two ways—TTL high is usually considered as true and TTL low is considered as false; it is equally valid to define TTL low as true and TTL high as false. Using this negative, or inverted, logic changes the functions of most logic gates (e.g., a NAND gate becomes a NOR gate when the logic definitions are inverted).

Since it is convenient to mix both true and inverted logic definitions in any complicated logic design (it makes the design simpler), some convention must be followed in naming the lines to indicate their logic definition. SWTP uses an overbar to indicate that TTL low is defined as true; WM uses a superscript * for the same purpose. WM data lines are called DB0-DB7, indicating high level true, while SWTP data lines are called $\overline{D0}$-$\overline{D7}$, low level true. Other examples are the WM WRITE* line, which write enables the memory and I/O when it is low, and the SWTP BA line, which indicates the SWTP bus is available when it is high.

Several control signals from the WM bus must be modified before being placed on the SWTP bus. CLK, the WM phase 2 clock signal, must be inverted to serve as $\overline{\emptyset 2}$ on the SWTP bus. MEM and IO, used by WM for enabling memory and I/O devices, must be combined (using a NOR gate) to provide $\overline{VMA}$, which the SWTP bus uses for both purposes.

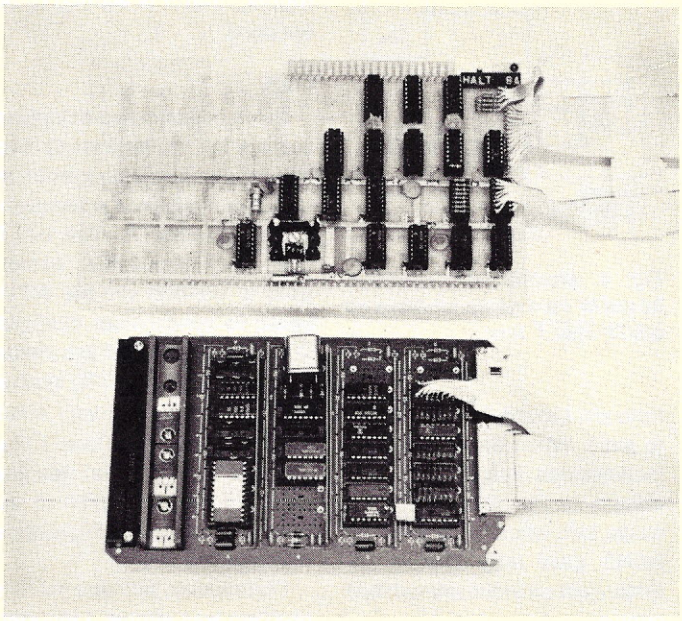
Memory and I/O Access

It is convenient to have the interface modify both memory and I/O port addresses. This allows both computers to see their own memory starting from 0000 and, in my setup, extending to 3FFF. The WM, however, sees the SWTP memory from 4000 to 7FFF and uses locations FF00 to FFDF for output ports, while SWTP uses 8000 through 801F. The interface allows it to address the SWTP output ports as if they were located from FF00 to FF1F on the WM bus. This allows the WM monitor, which assumes I/O ports are located from FF00 up, to be used with the SWTP I/O devices.

I used data-selector logic to get different offsets for memory and I/O addressing. The 74LS157 quad 2-line to 1-line data selectors act as 4-pole double-throw switches. Two 74LS157s are used in the interface to allow the WM IO line to control the offset in the address placed on the SWTP bus. When IO is high, indicating that the WM is addressing its I/O ports, the B inputs on the data selectors are selected. These inputs are hard-wired to give an address of 80XX. When IO is low, the A inputs are selected. These inputs have A15 wired low and A14 inverted from the WM bus.

These address-line modifications shift addresses in the range 4000 through 7FFF on the WM bus to 0000 through 3FFF on the SWTP bus. WM addresses not in the range 4000 to 7FFF or FF00 to FF3F will not enable the interface and can be ignored. The upper limit of 7FFF is necessary in my system to prevent interference with the WM video display memory at 8000 to 87FF. The display memory could be relocated (by reprogramming one of the monitor EPROMs), and all 32K of the SWTP memory space made accessible with minor changes in the interface logic.

The enable circuitry for both memory and I/O access to the



The complete interface. Only the two rear rows of the WM board (bottom of photo) are used in the interface. The other two rows are a WM serial interface.

SWTP bus requires that BA be high, which means that the SWTP A board is either halted or not plugged into the bus. Additionally, when BA is high, AB15 is low, AB14 is high and MEM is high, the 8T97 drivers on the SWTP bus are enabled for memory access. When BA and IO are high, AB7 is low and AB6 is low, the drivers are enabled for I/O access.

The data bus drivers are enabled whenever the 8T97s are enabled, but the direction (read or write) depends on the WRITE* line. The enable signals for the bus transceivers are generated and used on the SWTP interface board, but they must also be sent to the WM board to control the transceivers there.

Both the 8833 and 8T26 bus transceivers have their bus input and output terminals connected to the buses. This means that when the 8833s are enabled to write to the SWTP bus, the 8T26s must be enabled to read from the WM bus. Therefore, the read enable line for the SWTP becomes the write enable line for the WM, and vice versa. The 8833 enable inputs for both reading and writing are active low, but the 8T26 enable for reading is active high (the enable for writing is active low). I inverted the read bus line from the SWTP on the WM board before sending it to the 8T26 write enable input.

The RPLY* line is used by the WM to allow stretching the WM CLK signal when accessing slow memory or I/O chips. The WM CLK signal is held high (up to 3.5 microseconds—us) until approximately .5 us after RPLY* goes low. Since the SWTP devices must be fast enough for a 1 MHz clock, RPLY* is pulled low by the interface whenever it is enabled and CLK is high.

The Master-Slave Relationship

Now let's look at how the WM can halt the SWTP when it wants to use the SWTP bus. The 6800 chip allows DMA by three different methods: halting, cycle stealing and multiplexing. The simplest method, and the only practical one using the SWTP, is halting. The SWTP MP-A board, which contains the CPU, the clock and the MIKBUG ROM and RAM, is designed for DMA by halting, but it does require a very minor modification for full DMA. Before we discuss the modification, let's look at how DMA by halting works on the 6800.

The 6800 microcomputer is halted, logically enough, by pulling the $\overline{\text{HALT}}$ line low. This line may not change state ex-

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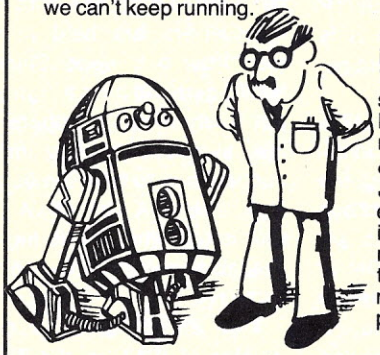

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cept during the first part of the machine cycle, but SWTP has provided a flip-flop, clocked by the phase 1 clock, on the MP-A board to satisfy this requirement. Therefore $\overline{HALT}$, the SWTP bus line, can be pulled low or allowed to go high at any time. When low, the 6800 will complete its current instruction, remove itself from the bus and then set BA high. This process can take from 2 to 15 us, depending upon the current instruction.

The delay between pulling $\overline{HALT}$ and actually having the bus available (BA high) means that we cannot simply pull $\overline{HALT}$ and simultaneously use the bus. Some means of latching the SWTP into its halted state must be used. I used a flip-flop on the WM board for this purpose. When the WM addresses FFDC, the flip-flop is clocked, causing its output to change state. The output is connected, through a unidirectional line, a NAND gate and an inverter, to the enable input of an 8T97. This pulls $\overline{HALT}$ low when it is enabled and serves as a driver for the BA LED indicator on the interface board. The other input of the NAND gate is connected to a switch on the board to allow manual halting of the SWTP.

The CLR input on the flip-flop is connected to +5 volts from the SWTP board. This initializes the flop-flop to the non-halted state when the WM is powered up before the SWTP. It is important to allow the SWTP to initialize itself before it is halted, even if its CPU is not going to be used.

Although the SWTP MP-A board appears to have been designed for DMA by halting, the circuitry to control the data bus drivers when the CPU is addressing the MIKBUG ROM or RAM prevents a DMA device from reading from the bus. A simple circuit modification corrects the problem without interference to normal computer operation.

Two different logic paths are used by SWTP to control the direction in which the data bus transceivers are enabled. This is necessary because the data lines to the MIKBUG memory are connected directly to the CPU data lines rather than the data bus. When MIKBUG is addressed by the CPU (addresses EXXX or AXXX), the normal logic path is overridden by the MIKBUG path. The transceivers are now enabled to write to the bus while the CPU uses the MIKBUG memory. Since none of the boards on the bus are enabled at this time, the data on the data bus are ignored.

When the computer is halted, the normal logic path is disabled, but the MIKBUG path is still active. When the R/$\overline{W}$ line is low (DMA device writing to the bus), the transceivers are enabled to read from the bus. This does not cause any problem. When the R/$\overline{W}$ line is high, the data bus transceivers are enabled to write to the bus, regardless of the address on the bus. This means that when the DMA device tries to read from memory or I/O on the bus, data bus drivers on both the board addressed and on the MP-A board are enabled. A prime rule of bus usage, "Thou shalt not have more than one set of drivers enabled at any time," is violated, and only garbage can be read from the bus.

To correct this problem, keep the data bus transceivers in a read from bus mode when the computer is halted. The first gate in the MIKBUG read/write circuit is a NAND gate used as an inverter by wiring its inputs together. When the output of this gate is high, the data bus transceivers are held in the read from bus mode. Since a NAND gate will have a high output when any of its inputs are low, separate the two inputs and use one to hold the output high when BA is high. A line that is low when BA is high is available, conveniently, on the same IC.

The NAND gate is one-quarter of IC12 on the SWTP MP-A board. Pins 4 and 5 of this IC are the inputs tied together to make an inverter, and pins 1 and 2, also tied together, have a line connected to them that is low when BA is high. I cut the foil connecting pins 4 and 5 and ran a short length of insulated wire

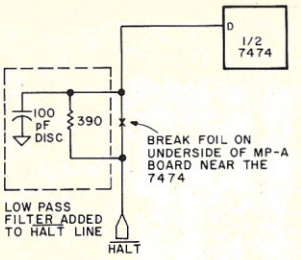

Fig. 4. Modification to MP-A board to cure noise problem on SWTP $\overline{HALT}$ line.

from pin 4 to the line coming into pin 1. When BA is high, this modification keeps the transceivers in the read from bus mode, but, when BA is low, the NAND gate acts like an inverter, just as in the unmodified circuit.

With this modification (or, for that matter, without it), the interface cannot read or write the MIKBUG ICs. Because of the MP-A board's design, no DMA method can use the MIKBUG ROM or RAM without added circuitry on the MP-A board. Because of the difficulty of modifying this board, I suggest that if you need this capability you relocate the MIKBUG circuitry to some other card in the system (e.g., the interface card).

One of the ways I hope to use my slave computer is as an I/O controller for the master computer. By connecting all of my slow I/O devices to the slave computer bus and programming it to handle the printer, cassette, etc., which often take the majority of a microcomputer's time, the time available to the master computer to do calculations and data manipulations is greatly increased. There is nothing original about this idea; I suspect all large computers work this way.

To make the interface more flexible, I've incorporated a line that allows the SWTP to inform the WM whenever it needs attention. When the SWTP addresses its 0 I/O port, the WM gets a signal on its #4 interrupt line. Since the WM uses a vectored, maskable interrupt scheme, it can be programmed to go to an I/O service routine when it is ready for I/O and the SWTP has indicated, by interrupting, that it is waiting to be serviced.

Bugs

I have used my two-computer system for approximately two months, and only one problem has come to light: a noise problem in the SWTP! The HALT line, as I mentioned earlier, uses a flip-flop on the MP-A board to synchronize changes in the HALT line with the phase 1 clock. This is a TTL device that will respond to very short pulses on the bus line. I discovered that noise on this line was causing the SWTP to execute occasional single-cycle operations.

Fortunately, the cure for this problem was simple. I inserted a low-pass filter into the line on the MP-A board before it reaches the flip-flop (see Fig. 4).

This problem was due to noise pulses originating in the interface, not on the SWTP bus. It will not cause trouble if the SWTP is halted by means of a switch connected directly to the bus line and ground with short, reasonably large, wires.

Summary

Few, if any, will want to build an exact copy of my interface. However, the basic interface design and many of the ideas are applicable to anything from adding a bus to a one-board microcomputer to interfacing two microcomputers using different CPU chips. This is a wide-open area for hobbyist exploration.

Many people probably feel that interfacing two different computers is too complicated for anyone without an extensive technical background. Actually, if the two computers use the same CPU chip, it is a straightforward and rewarding project. It took me less time to design and build the interface between my two computers than to build an RS-232 interface for my keyboard/printer. All of the critical timing relationships are already taken care of by the computers. All you must do is get the signals between the computers and modify those signals that are different on the two buses.■

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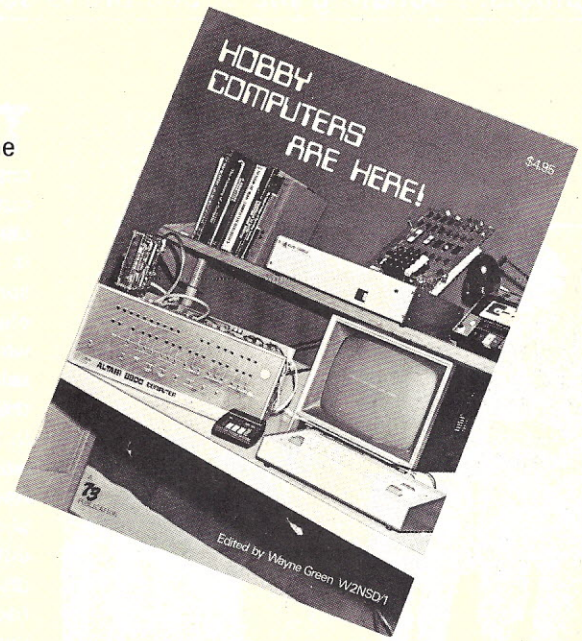

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Computers in Classrooms: Teaching the Teachers

Three big markets for personal computers will exist in years to come: small businesses, homes, schools. Educating the educators is something we can all get involved in.

Photo 1. A large computer installation. *(Courtesy of IBM)*

Today there is no reason why every elementary and secondary school should not have computers. Their potential uses are obvious and their cost is remarkably low. But widespread use of computers in classrooms will come only when teachers realize their value. This article discusses the possible uses of computers in classrooms, and describes workshops my associates and I have held for local teachers. My aims, here, are to present the criteria for these workshops, discuss the problems that we faced in organizing them, describe what we learned from our experiences and encourage others to help in this task of "educating the educators."

Facing the Problem

Any reader of this magazine is certainly aware that computers will soon be as much a part of daily life as typewriters, refrigerators, automobiles and television sets. Such everyday items surely must be part of classroom education at all levels. Students must grow up with the computer much as they grow up with the other products of our culture.

But the computer is not only a new household item, it is also a versatile tool that can aid in education. Computers can handle routine tasks such as grading and record keeping; help in generating class materials and providing self-paced review; and even supply simulated experiences ranging from simple games to complex system tasks. The possible uses of computers in education are unlimited. Now the sharp reduction in the cost of computers has made many of these uses economically feasible.

One obvious problem is that few teachers have the background required to take advantage of computers. Even science and mathematics teachers have seldom had more than a cursory (and often outdated) introduction to computers. These introductions typically treat the computer as a high-powered calculator, capable only of solving mathematical problems. Most teachers share such common public myths as:

1. Computers are intelligent and answer all questions posed

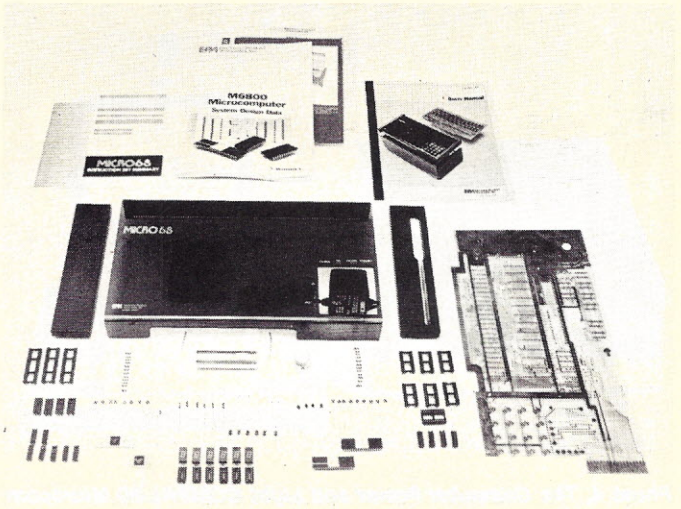

Photo 2. The Electronic Product Associates Micro-68 (exploded view shows components). (Courtesy of Electronic Product Associates)

to them (presumably in an eerie metallic voice).

2. People who work with computers must be wizards or mathematical geniuses. Computers remain remote and mysterious to the "man on the street."

3. Computers are depersonalizing, unimaginative and insensitive. Furthermore, they will eventually take over everything.

4. Computers are always right, or at least think they are. Somehow, though, they can always be outsmarted by a few extraordinary (or even ordinary) people.

5. Computers are large, very expensive and very complex. Average people can only look at an installation like that shown in Photo 1 from behind closed doors.

Even teachers who have some computer background are often unfamiliar with the new, low-cost microcomputers. Since teachers are already expected to be expert in sociology, anthropology, psychology, ecology, health and other subjects, this lack of familiarity can hardly be surprising.

On the other hand, most computer specialists (like myself) are unfamiliar with the problems of elementary and secondary teachers. Their needs and requirements are different from those of teachers at the college level. Elementary and secondary teachers need solutions to their problems, not just new tools that are difficult to use or understand and will simply clutter the classroom.

The Role of Computer Clubs

The personal-computer movement has some unique characteristics that can be used to solve this educational problem.

- Many personal-computer enthusiasts are newcomers to computing. They can therefore help alleviate fears that only experts can understand computers. Many computer-club members are themselves teachers.
- Personal-computing stores, magazines, conferences and clubs cater to the novice. They provide information at a variety of levels. Furthermore, other hobbyists are often willing to help novices.
- Personal computers are not financially out of reach for most schools. Complete units can be priced as low as $600, a cost comparable to that of a typewriter or television set.
- Personal computers are designed to be used by non-experts. Their size, appearance and operating methods make them far less forbidding than larger computers and far easier to explain.

Planning a Workshop

The potential for personal computers in the classroom is there but how do you translate it into reality? The rest of this article will deal with our experiences in offering personal-computer workshops to teachers. I hope you'll get some idea of approaches to take and pitfalls to avoid.

The original idea grew out of a microprocessor course I offer at Grossmont College. Although the course is primarily intended for engineers and technicians, many hobbyists also take it. Among my students was Dr. Russ Cassel, a well-known specialist in computer-aided instruction who is presently retired from the U.S. Air Force and from a professorship at the University of Wisconsin, Milwaukee. It was Russ who suggested we hold a workshop for teachers.

Since I am interested in continuing education and have given some workshops for engineers, I decided that the idea was worth pursuing. Our group finally decided on the following guidelines:

1. We would not assume that attendees had any previous background in computers.

2. We would emphasize the current state of the art in low-cost computers.

3. We would try to emphasize that you didn't have to be either an expert or a mathematical genius to use a computer. One approach would be to have local teachers and other non-experts explain how they were using computers.

4. We would try to give all participants some hands-on microcomputer experience.

5. We would hold all-day Saturday workshops at no charge.

Our net assets when we started were:

1. Cooperation from Grossmont College, which provided a room, reproduction of materials and some secretarial help. This was largely arranged by Dr. David Lien.

2. Cooperation from a local microcomputer manufacturer, Electronic Product Associates. This manufacturer agreed to supply us with some Micro-68s for the hands-on experience. The EPA Micro-68 is a Motorola 6800-based microcomputer that has a hexadecimal keyboard and display (see Photo 2), and can therefore be used without a terminal. It is also available in more elaborate configurations (see Photo 3) with various peripherals.

3. Help from some local computer enthusiasts, including present and former teachers.

Finding Willing Victims

What we lacked (besides good sense) were teachers (i.e., guinea pigs for this experiment). The obvious place to start was at nearby high

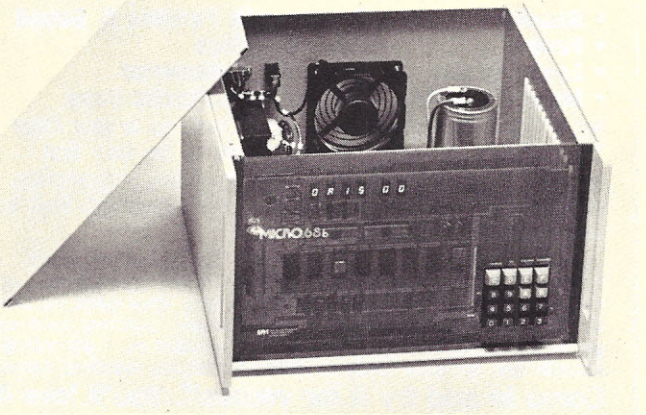

Photo 3. The Electronic Product Associates Micro-68b, a larger version of the original Micro-68. A printer, TV interface, cassette interface and floppy-disk system are available with this computer. (Courtesy of Electronic Product Associates)

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This is how it works: Whatever information you wish to store is automatically cross-indexed under "Subject" and "Tag" headings you designate. Using **WHATSIT's** pidgin English Requests, you may add or change headings, as well as data, at any time. Because the system maintains headings in disc storage, they may be changed readily by the program itself.

CONVERSATIONAL QUERY CAPABILITY

Data retrieval is equally easy. You can query the system directly about any data item on file, or you may inquire about any heading. All that's required is a pidgin English "Request," such as "WHEN'S DR. JEKYLL'S APPOINTMENT?" System response time is usually a matter of seconds.

Up to two headings may be specified in a single Request, a capability that makes possible versatile cross-indexing within the data base.

INSTALLATION

For easy installation, the **WHATSIT** programs are supplied in the widely available North Star BASIC, and can be installed without modification on any S-100 bus (8080 or Z-80) computer equipped with a North Star disc system and at least 24K bytes of random access memory (RAM). For other disc systems or non-compatible computers, the programs would require modification.

SPECIFICATIONS
MODEL NS-3, Version 1

Hardware compatibility: Any S-100 Bus (8080 or Z-80) computer with one North Star disc system and 24K of RAM (random access memory).
Language: North Star BASIC, Version 6 Release 3.
Request types: Store, Scratch, Change, Add, Spill (6 types including Indexed, Selective, and Analogy), plus special Requests.
Response time: Normally 3 to 10 seconds.
File capacity: 1500 to 3000 entries per disc, depending on average entry length.
Indexing: Every entry automatically indexed by Subject, Tag, Object.
Request length: Up to 100 characters.
Entry length: Up to 30 characters.

WHATSIT is available for $75.00 as a Ready-to-Run System, including three programs on Northstar disc and a 100-page user's manual written in non-technical language. The manual may be optionally ordered for $25.00. Besides detailed startup and operating instructions, the manual includes complete programs listings in BASIC.

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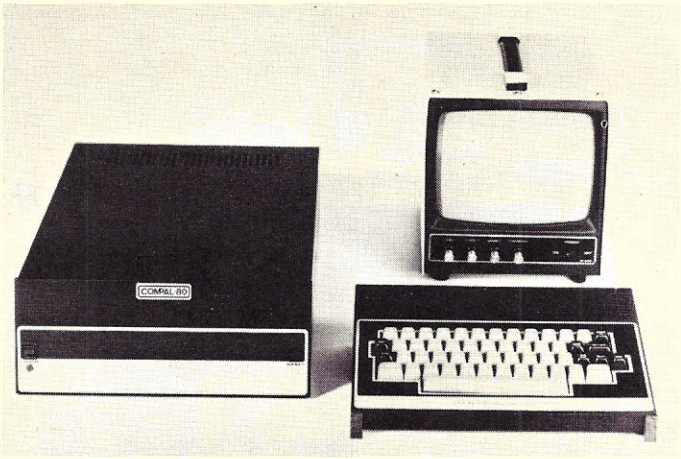

Photo 4. The Computer Power and Light COMPAL-80 Microcomputer. This system comes completely assembled, including the keyboard and TV monitor, for about $2300. Printers and floppy disks are available at extra cost. (Courtesy of Computer Power and Light)

schools; so we started to wade through the various bureaucratic levels. Surprise—the people at the first school we contacted were positive and enthusiastic. They had been using a time-sharing system and were anxious to learn about micros. This response was, of course, encouraging, and it turned out to be the only encouragement we would receive from any school.

The general response was: "What are you trying to sell?" "The person who handles computers is on vacation." "We're busy right now with exams, parent-teacher meetings, law enforcement, football, etc., but do call us back (preferably when we're out)." "I'll route the matter to our mathematics coordinator; he (or she, or it) will get back to you. But don't hold your breath."

The lesson here is that you'll need some patience (and some aspirin). Teachers are not lining up, waiting to find out about computers. You have to reach them and sell them on the idea; and that takes time and effort. A few notices or a few telephone calls will not do the job.

Fortunately, we wanted to start small and we had no illusions about a huge crowd. (Remember that we wanted to include hands-on experience.) In fact, our initial group was fifteen, padded by two deans from Grossmont College and a few ringers from the local computer club.

The Initial Program

The program consisted of two talks: one by me and another by Dr. Melvin Zeddies of United States International University. Mine, "An Introduction to Computers," described what a computer was, what made up a working system, what was presently available and how much it cost, what the future trends might be, where you could get more information, and how you might want to use a computer in the classroom. Copies of the slides are available from me for anyone who is interested.

Dr. Zeddies talked about his experiences in building several small computers for use in a high-school program for gifted students, covering such matters as how to obtain funding, build and maintain the computers, write programs, and provide some continuity in computer operations.

In addition, three local computer enthusiasts—Gary Mitchell, Laura Thomas and Carl Palechek—described their experiences with personal computers. The program was rounded out by a laboratory session which involved writing and executing several short machine-language programs.

In general, our participants found the workshop interesting

but had some reservations. Our real problem was that the EPA Micro-68 computers were not the type that would be useful at the elementary or secondary levels. These computers are really intended as digital trainers or prototyping systems for engineering applications. Several teachers suggested that they were interested in complete systems with adequate peripherals that could be programmed in a high-level language (preferably BASIC).

Furthermore, we had to show the teachers that personal computers could be a useful classroom tool. Several teachers said they needed to see things that they could use immediately, rather than just hear suggestions. We had to sit down and really think about how to sell teachers on utilizing computers.

The participants generally did not want to assemble kits, attach peripherals or maintain their own computers. They had neither the facilities nor the time for that approach. The only attraction of kits was that they could be purchased as instructional supplies rather than as capital equipment. Most school districts (like many companies and government agencies) have elaborate procedures for purchasing computers. Although these procedures make little sense now that computers are so inexpensive, they will remain an obstacle to computer purchases for many years.

Some Further Efforts

Since that first effort, we have held two more workshops. We now have cooperation from Computer Power and Light, a manufacturer of complete microcomputer systems that include a keyboard, monitor and audio cassettes (see Photo 4). These systems come assembled, and can be programmed in BASIC. The manufacturer provides local maintenance and some software. We are now trying to emphasize the use of computers to aid in remedial education (they have infinite patience), to provide simulated experience and to help teachers perform routine tasks.

The problem of reaching our potential audience remains a serious one. Clearly a small volunteer group cannot put a massive, continuous effort into publicity, personal contacts and telephone reminders. We are now trying to work through the San Diego County Department of Education and we're hoping the department can handle the difficult task of reaching that audience.

Overall, I think this experience has been useful, even though it is little more than a beginning. In fact, I may have learned more than the teachers since I have become acquainted with school administrations, financing methods, district policies and school problems. I have had an opportunity to see Bob Albrecht in action (he's fabulous), and to meet a large number of concerned educators.

Some Suggestions

Teacher education presents a real opportunity for local computer clubs and enthusiasts. I suggest the following guidelines.

1. Work through your local school district or county department of education. Otherwise the problem of publicity is enormous.

2. Explain computers from the beginning. Don't assume teachers have any background, particularly familiarity with the personal-computer movement. Remember that S-100 bus, Altair, Imsai, floppy disk, RAM, ROM and other such terms are not common knowledge.

3. Emphasize how teachers can use computers to help with everyday classroom tasks. Try to bring in local teachers who have actual experience with small computers.

4. Don't hesitate to include some games and other attention-grabbers—teachers are almost human, after all. Include some useful programs as well.

5. Include some organized hands-on experience, preferably involving programming low-cost computers in BASIC.

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Actual experience is the only way to overcome the fear of computers so many people feel.

6. Discuss sources of additional information and equipment. These sources include computer clubs, stores and magazines. *Calculators/Computers* magazine is a new journal that deals specifically with educational applications. (I will gladly provide a list of selected books and magazines.)

7. Emphasize complete systems that do not require a high level of expertise to build, use or maintain. Explain some of the pitfalls, but don't make the road seem too hard to travel.

8. Be sure to note that we don't have all the answers yet. The entire personal-computer business is only a few years old, and most of the exciting developments are still ahead of us.

9. Try to get actual systems into schools, even if just for an afternoon. In-school demonstrations help create publicity and encourage students and teachers.

Acknowledgements

I am glad to be able to thank the following people for their invaluable assistance:

Dr. Russ Cassel, whose energy and enthusiasm should be a guide for all of us.

Dr. Melvin Zeddies, a first-class speaker and educator.

Dr. Jane Gawronski of the San Diego County Department of Education.

Dr. David Lien, Mr. Leslie Phillips and Ms. Margie McMurray of Grossmont College.

Mr. Victor Wintriss and Ms. Patti Neumann of Electronic Product Associates.

Mr. Michael Scholnick, Ms. Dianne Simpson and Mr. Ian Law of Computer Power and Light.

Mr. Wirt Atmar of Ai Cybernetic Systems, for providing a cassette describing Cybernetic's speech synthesizer.

Also—Carl Palechek, Ed Nagy, Gary Mitchell, Laura Thomas, Irv Stafford, Peter Young, Robert King, Lewis Freed, and many others. John Craig of *Kilobaud* has been a constant source of encouragement.■

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H. Dyk, "Put a Micro in Your School," *Kilobaud*, June 1977, pp. 38-40.

D. Inman, "Computers for Free!" *Kilobaud*, March 1977, pp. 42-45.

S. Clarke, "A PET for Every Home," *Kilobaud*, September 1977, pp. 40-42.

Calculators/Computers magazine, edited by Don Inman (assisted by Bob Albrecht). Available for $12 per year from DYMAX, PO Box 310, Menlo Park CA 94025.

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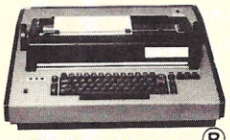

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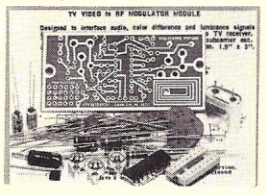

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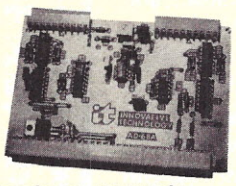

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Two Heathkit User Organizations??

You may have noticed that there are two entirely separate organizations for Heathkit computer users. HUG is the official Heath sponsored organization. The second organization publishes a periodic news letter called BUSS. This second organization is not affiliated with Heath Company in any way. Neither is it approved, sanctioned, or recommended. Heath Company bears no responsibility for the material it publishes or the advice it gives. The official, inside word will always come through HUG. If you want the latest word on new products, software updates, and other juicy news, keep reading REMark.

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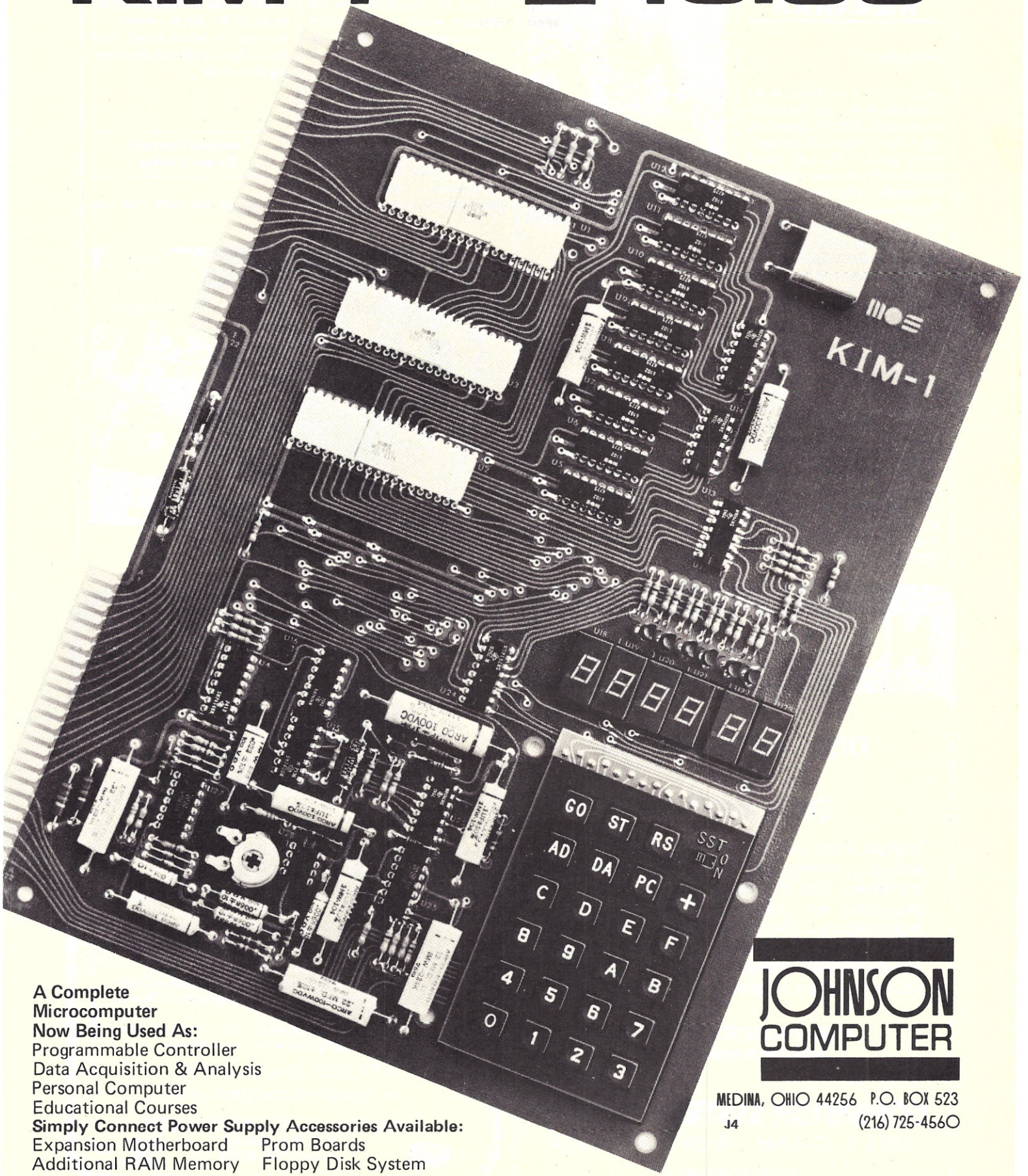

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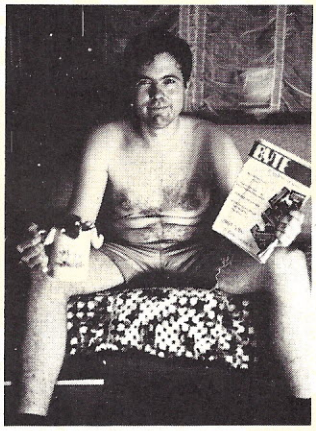
PUBLISHER'S REMARKS

(from page 7)

the case: ". . . the plastic is not strong enough to keep the fasteners in place. After I opened the top a few times both fasteners broke loose." He also found trouble with the cover uprooting the keyboard when he removed it. He particularly had trouble with the color TV monitor and discussed that at great length . . . including a severe problem he had with radio frequency hash from the computer. He stressed this a couple of times and then went on to gripe that there were no peripherals available for the Apple bus.

He didn't like the game paddles supplied, so a great deal of the article was devoted to his making his own joystick, an engineering triumph of which he seemed extraordinarily proud. He left me with the strong impression that before I could do much with the Apple I would have to duplicate his chore of buying all the parts and building my own joystick. I would then have to dig into the Apple and wire my new control



Byte *editor Helmers.*

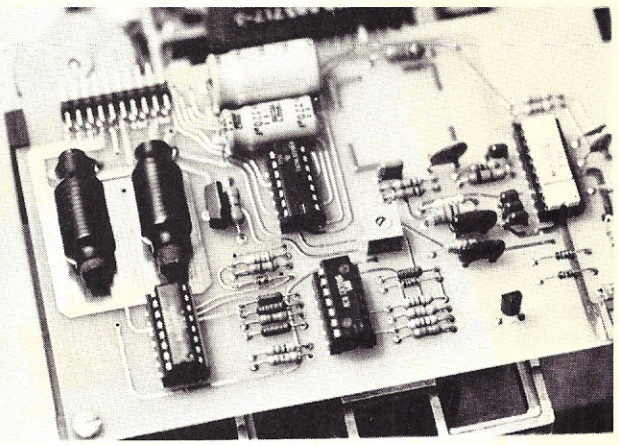
system directly into the computer before I could use it. This would obviously ruin the portability of the unit and I doubt if I could get the bottom cover back on. Phooey.

Helmers didn't like the BASIC supplied. "But the 5K BASIC, even given its string capabilities, is not what one would want to use. . . . The people at Apple have hacked the (BASIC) interpreter . . . had to sacrifice two statements: LET and REM." This in order to have graphics. He beefed about the lack of the high-resolution software package . . . called the applications software "a mixed bag" . . . didn't like the loose-leaf documentation and the lack of tutorial on how the computer works . . . and found the documentation "scanty" on the BASIC interpreter.

Absent from the review was any objectivity or discussion of the benefits of the system to the beginning computerist. He said nothing about where one could get applications software for the system . . . how easy it is to use and to learn . . . how many people are able to sit down and learn the fundamentals of microcomputing in a few hours with the Apple, etc. Obviously he had no interest in the tremendous enthusiasm of the Apple owners . . . any one of whom could have done a far superior job of reviewing the system.

Computer Portraits: Up and Coming

Most of use have run into



Apple controller.

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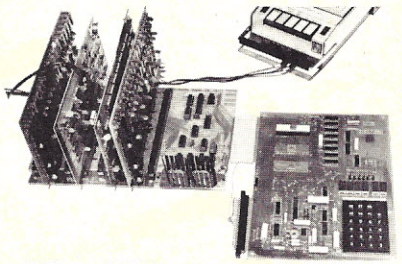

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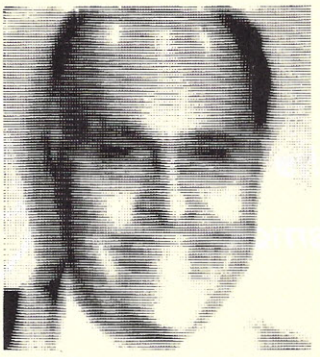
computer-portrait outfits at shows, shopping centers, fairs, vacation spots, etc. It turns out, according to a release from Centronics (which we'll be publishing) that there are fortunes to be made with these systems.

One of the exhibits at the San Jose show was a portrait system by Micro Works, a new outfit in Del Mar (California, of course). Their price for a complete system was ridiculously low . . . around a quarter that of one of the lowest-priced commercial systems. While the cost of the equipment needed to make $100,000 in sales (mostly profits) over a six-week period is not relevant if it's under $50,000 . . . not many locations will produce that amount of dollars . . . so a few bucks saved is a few bucks earned.

Since many computer hobbyists are not totally opposed to making money with their systems, we'd like to have some articles on commercial applications of microcomputers . . . such as for computer portraits.

First European Microcomputer

The European agents for *Kilobaud* have forwarded information on NASCOM 1, a microcomputer kit selling for 980 DM (from an address in Trier, W. Germany). The system uses a Z-80 chip and has its own bus structure, which the literature doesn't divulge. They do have a NASCOM to S-100 bus interface board available, so any of the hundreds of S-100 boards can be used with the system. They also have a Kansas City cassette interface available.



The kit includes a full alphanumeric keyboard and character generator. It requires a TV set for video display and a separate power supply (another 130 DM). It appears to have 4K of memory and includes a small operating system (NASBUG) in ROM and its own cassette system, not compatible with any other known system (as usual).

My plans are to be in Europe in May, and I hope to have a fuller report on NASCOM after the May show in Paris. Trier is quite near the Luxembourg border, and is not that far from Paris. It is a beautiful old city, with many Roman ruins . . . such as the remains of extensive outdoor baths, and a coliseum for Roman games. I won't have a chance to get up there to see the NASCOM distributor; however, perhaps I will have a chance to visit the factory in the UK on the way to Paris.

Buying Mail Order

There are several firms that are not permitted to advertise in *Kilobaud* because we have had so many complaints about them. But, outside of checking the ads in *Kilobaud*, how can you protect yourself against rip-offs? Not that an ad in *Kilobaud* is positive proof of anything because we get taken in too . . . and of course there are still some credible advertisers who are not running ads in *Kilobaud* for reasons of their own . . . odd as this may seem.

To get your best shot at not getting a bad deal, I suggest the following procedure. This has to do with firms about which you may have a question . . . not steady advertisers in *Kilobaud* such as S.D. Sales, Godbout, etc. Before you plunk a big bunch of money in an envelope, take some precautions.

1. Write a letter to the firm asking for a confirmation of prices and a definite commitment on delivery within two weeks of your order. Keep a copy of this letter in your files.

2. If they do promise delivery within two weeks, it is time to place your order. If they say no, it is time to hold off until they get their act in shape. If you are going to order, send them a certified check or money order for the amount, or the order and a letter explaining exactly what you are ordering, giving every possible detail. State clearly that shipment is to be made within two weeks or else your check is to be returned. Send this letter by certified mail, with a return receipt. This costs a dollar and may be worth it. If you are not extremely clear in your order it could delay things while the firm writes to find out what baud rate you need, etc. Keep a

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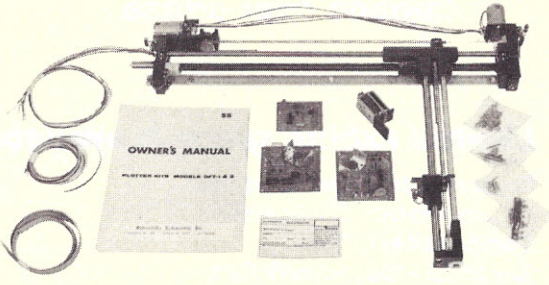

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couple of copies of the order and check.

3. If you have heard nothing in a month it is time to get into action. Write a letter asking for the return of your money. Send a copy of your order to the firm and point out their promise of delivery within two weeks. Tell them that unless they respond immediately you will take the matter to the mail-order-fraud department of the post office, to your attorney general, and to the Better Business Bureau in his town. Keep a copy of this letter . . . and send me a copy.

4. If you hear nothing further within ten days, it is time to write to the post office, the attorney general, Better Business, and anyone else you can think of who might be interested. By all means, send a copy of the correspondence to me. I don't want to run ads from firms like this . . . and I just might be able to help you get your refund.

Book Manuscripts Wanted

The *Kilobaud* book department has been expanded recently and several books are in the works; more are needed . . . if you are looking for fame and fortune.

A publisher has two major functions, and *Kilobaud* is uniquely suited to both of these. First comes the printing of the book, which can be an expensive proposition. In our case, we edit the manuscript, do the drafting of any schematics, set the type, do needed photography, proofread the type, lay out the pages, put the type, photos and draftings together on the page, shoot the negatives, make the printing plates, buy the paper, print the book, bind it and ship it. Everything is done right at *Kilobaud*! Few publishers have such a complete setup . . . or one nearly as efficient.

The second function is advertising and distributing the book. Again we have everything, including a magazine to help with the advertising. Our marketing staff prepares promotions for computer stores, bookstores, radio stores, etc. Our sales staff is in touch with all possible book outlets. With over a dozen books now being distributed, we know the market well.

What kind of books are needed? Microcomputer-fundamental books are still selling well, despite the large number of them out there. Books of programs for microcomputer-users are exceedingly popular. Books on programming sell well. Heck, almost any book on computing sells. What are you waiting for? Wouldn't you like to see your name on a book cover?

If you have a book in the works you can do worse than get in touch with our book department and see if you have something viable. It sure is nice when those royalty checks come in.

Good News and Bad News

Perhaps you've noticed that prices on everything have been inching up. As long as we are all so enthusiastic about supporting an ever-growing government, one that has a strong vested interest in spending, not saving, inflation is going to be a fact of life. You've probably read about the recent postal hike and you may know about the next one that's coming. I sense that something has changed in postal rates for magazines when I have to pay 72¢ a copy to mail an issue of *Kilobaud* and remember when I paid 5¢ each to mail *73 Magazine*.

The excuses include more than postage. Paper has doubled in price in recent months, with the grades of paper we used to use being phased out and forcing us to use what the paper mills are making . . . paper so thin it is getting difficult to turn a page without skipping one or two and hardly noticing it. Printers, needing bigger Rolls Royces and yachts, have upped their take . . . and so it goes.

The bottom line is an increase in *Kilobaud*'s one-year subscription to $18. Since about half of our subscribers opt for a three-year subscription for $36, and we are not increasing this price, the net to us will be about 11 percent. This will put us back where we were when *Kilobaud* started.

With a very high percentage of the renewals coming through for three years, it will be the newcomers to the magazine who will foot the inflation on the one-year rate.

EDITOR'S REMARKS

(from page 7)

or give me a call for reservations and booth costs.

John Craig, RFD Box 100 D, Lompoc CA 93436, (805) 735-1023.

Article Submission

Hey, if you're going to write an article *don't* send it to more than one magazine at a time, OK? That isn't the way the game is played. I don't think any of us likes to be put in a position of "bidding" on a piece of material (and I won't), but even worse than that are the possible messes that can occur.

My most recent experience involving dual submissions resulted

LETTERS

(from page 20)

```
210 IFS(A)<>0THEN350\M2=0
215 Y1=Y1+1
220 FORZ9=0TO8STEPQ9
225 IFC9(A,Z9)=0THENEXIT320
230 A6=C9(A,Z9)\A6=V(A6)
240 IFA6<0THEN300\IFA6=11THENV(A9)=-1
260 IFA6=3THEN265\GOTO270
265 M4=A\GOTO390
270 IFA6=0THEN300
280 IF5>A6THEN285\GOTO290
285 M2=M2+A6^A6\GOTO300
290 A7=INT(A6/5)\IFA7=A6/5THENM2=M2+A7
300 NEXTZ9
320 IFM2>M3THEN325\GOTO350
325 M3=M2\M4=A
350 NEXTA\IFY1=1THEN355\GOTO390
355 PRINT"IT'S A DRAW"\END
365 FORA1=0TO3\A6=W(A1,M5)\IFS(A6)=0THEN366\GOTO367
366 M6=A6
367 NEXTA1
368 PRINT"THE OLD",M5
370 S$(M6,M6)="C"
375 A1=INT((M6-1)/16)+1\A2=M6-((A1-1)*16)
380 PRINT"I WON WITH BOARD",A1," POSITION",A2\GOSUB1000
382 END
390 S$(M4,M4)="C"\S(M4)=5
391 U2=M4\U4=5\GOSUB1400
392 A1=INT((M4-1)/16)+1\A2=M4-((A1-1)*16)
400 PRINT"I WENT BOARD ",A1," POSITION ",A2\GOTO90
410 PRINT" "\PRINT"YOU WON"\GOSUB1000\END
1000 PRINT"POSITIONS ARE",\FORA=0TO3\FORA1=1TO13STEP4\A2=20+(A1*4)
1100 PRINTTAB(A2-4),A+A1,\NEXTA1
1102 PRINT" "\NEXTA\PRINT" "\PRINT" "
1105 FORA=0TO3\PRINTTAB(A*15),"BOARD",A+1,\NEXT\PRINT" "
1107 PRINT" "\PRINT" "
1110 FORA=1TO4\FORA1=0TO48STEP16\A2=A+A1
1120 PRINTS$(A2,A2),S$(A2,A2),"/",
1121 PRINTS$(A2+4,A2+4),S$(A2+4,A2+4),"/",
1122 PRINTS$(A2+8,A2+8),S$(A2+8,A2+8),"/",
1123 PRINTS$(A2+12,A2+12),S$(A2+12,A2+12),"   ",
1124 NEXT
1125 IFA=4THEN1130
1127 PRINT\FORA2=1TO4\PRINT"///////////   ",\NEXTA2
1130 PRINT" "\NEXTA\PRINT" "\PRINT" "\RETURN
1400 FORU1=0TO8
1410 U3=C9(U2,U1)
1420 V(U3)=V(U3)+U4
1430 NEXT\V(0)=0\RETURN
```

from a record-keeping error on the author's part. It turned out he had submitted the article to another magazine, forgot about it and then sent it to *Kilobaud*. It initially blew my mind when I saw an article that I'd already bought in print . . . in another magazine.

We finally got things straightened out; but to paraphrase an oft-heard democratic dictum: "One article, one magazine."

NEW PRODUCTS

(from page 17)

age differential of bus signals that are asserted "high."

The Extensys device provides glitch-free signals (no spikes interference, crosstalk) by bringing some well-documented analog techniques from transmission-line analysis to the digital world of S-100 computers.

The "Glitch Grabber," which easily plugs into any open slot on the S-100 bus, features a proprietary self-regulating transistor network that controls voltages and modifies circuitry to handle less or more voltage; the circuitry is activated, however, only when the glitch is there, so it does not load the S-100 bus signals.

The "Glitch Grabber" is also very effective when used in business applications where reliable operations are of prime concern.

Extensys, 380 Bernardo Ave., Mountain View CA 94040.

PET-488 Cable Assembly

The Pickles and Trout PET-488 cable assembly makes your PET computer plug compatible with any IEEE-488 device. The PET computer can become the controller for a wide variety of electronic test equipment and computer peripherals. You can use your PET as the basis for an automated testing system or you can take advantage of the numerous peripheral devices (more appear every month) that can talk to the IEEE-488 bus.

The PET-488 cable assembly plugs directly into the edge connector on the back of the PET computer and has a completely 488 compatible connector on the other end. The cable itself meets all IEEE-488 specifications for shielding and crosstalk and is 18 inches (.45m) long. Price is $30 (California residents, please add 6 percent sales tax).

Pickles and Trout, PO Box 1206, Goleta CA 93017.

Professional Software

The Comprehensive Mailing List Program Package, #ML-1NS, is a modular program set which enables the user to start and effectively maintain one or more mailing lists. Operations include: Add, Delete, Search, Sort, Auto-Sort and Sequential Printout. Features include: user-selectable defaults for ease of entry, user-selectable number of labels across page for different printers and label sheets and user-selectable 3- or 4-line address for each independent entry. The program set is written for convenience and ease of use. Available with complete documentation and North Star diskette for only $25 ppd.

Delivery is from stock. Documentation package only is $4.50 ppd, fully refundable with order for diskette. Order from: Williams Radio and TV, Inc., Computer Division, 2062 Liberty St., PO Box 3314, Jacksonville FL 32206.

BOOKS

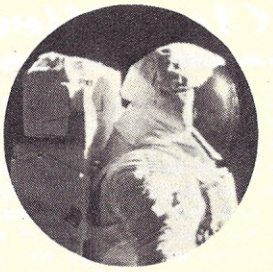
(from page 12)

impression of two guys talking to each other. The result is a very readable pair of books that are also extremely informative.

The books aren't flawless, of course. The most irritating things are the typographical errors. Fortunately, only a couple of them are likely to cause you any confusion while reading. An errata sheet will be available soon. Sorry, but even though I tried, I couldn't come up with anything else bad to say.

In short, these books are ideal for someone who is just getting into home computing. Even for the more experienced reader, they tie up a lot of the loose ends and show the relationships among things that may not have been clear before.

Tom Rugg
Los Angeles CA



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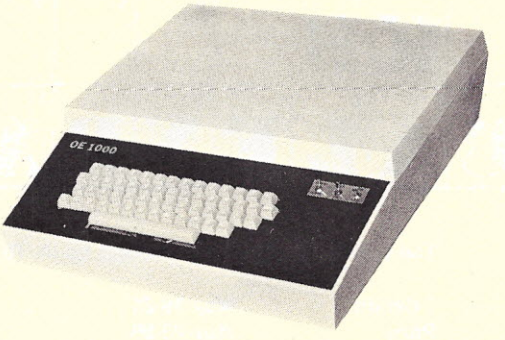

The OE 1000 Terminal is a low cost stand alone video terminal that operates quietly and maintenance free. It will allow you to display on a monitor or modified T.V. 16 lines of 64 characters. The characters can be any of the 96 ASCII alphanumerics, and any of the 32 special characters. In addition to upper-lower case capability it has a scroll up feature and full X-Y cursor control. All that is required from your microcomputer is 300 baud, RS 232 or 20 mA current loop, serial data. And if that is not enough the price is only $275.00 in kit or $350.00 assembled, plus $3.00 shipping and handling. To order phone or write:

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09

Kilobaud Classified

Kilobaud classified advertisements are intended for use by those individuals desiring to buy, sell, or trade used computer equipment or software. No commercial ads are accepted.

Two sizes of ads are available. The $5 box allows five lines of about 22 characters each, including spaces and punctuation. The $10 box provides ten lines of type – again, each line is about 22 characters. Minimize capital letters, as they use twice the space of small characters. Payment is required in advance with ad copy. We cannot bill, or accept credit. Oversize ads are not accepted. Each subscriber is limited to two (2) identical ads in any given issue.

Advertising text and payment must reach us 60 days in advance of publication. For example, advertising copy for the March issue (mailed in February) must be in our hands on January 1. The publisher reserves the right to refuse a questionable or not applicable advertisement. Mail advertisements to: KILOBAUD CLASSIFIED, Kilobaud, Peterborough, NH 03458. Do not include any other material with your ad, as it may be delayed.

PET owners—train your new PET with this software: try Dictator at $10 or King at $7.50, or a tape of 10 games at $20. Send SASE for complete list. Guaranteed. Dr. Daley, 425 Grove Ave., Berrien Springs MI 49103.

TDL Xitan, 34K—250n SMB, video display brd ZPU, keyboard, 12" TV, $2095, Jon Batcheller. (904) 373-7004.

Sophisticated 2-player football simulation on cassette for Radio Shack TRS-80 Level 1 BASIC. Uses graphics to draw field, move ball, etc. $12. Dr. S. Harter, Box 17222, Tampa FL 33682.

PET users need info? Getting started with your PET workbook, $4. Workbook has helpful info, sample programs, exercises and fundamental features of PET BASIC. Send SASE for details. D. Smith, Box 921, Los Alamos NM 87544.

ADM-3A with upper/lowercase. Brand new. Guaranteed working perfectly. $600. Write: Terminal, PO Box 2467, N. Canton OH 44720.

For sale: Heath H8, H9, 12 K mem assembled. ecp-3801 recorder Ext-BASIC and all supporting prog & doc. $1400. T. Bratcher, 1926 Woodslea, Apt 5, Flint MI 48507. (313) 744-3098 after 6 PM.

TRS-80 Horoscopes. Level 1 BASIC. Tutorial on horoscope and zodiac. Locates houses and planets. Any date 1800-2000. Single pass for 16K and three pass prog. for 4K. Both for $7.50 (tape). D. L. Pitman, 3045 Tuna Canyon, Topanga CA 90290.

All prime, 100% guaranteed, in tubes. CD4030—25/$7.50, CA3079—25/$12, 74S112—25/$10. 74116—15/$15. A. Khan, 2355 Burch Cir. N.E., Atlanta GA 30319.

For Sale: GE capacitors 26,000 uF at 30 volts dc $2 each or three for $5. Postpaid U.S. only. L.F. Carbaugh, PO Box 398, New Cumberland PA 17070.

For Sale: Altair 8800B w/broken protect switch (bat handle was accidently snapped off). Worked fine before the mishap. $650. Jeff Smith, 5638 Whitsett #16, N. Hollywood CA 91607.

Sell: Heath H9 terminal, expertly assembled, $550. 10 new DPI 8-in. disks, $50. I ship. Andy Thornburg, 400 E. Jackson, DeSoto IL 62924.

Imsai with front panel, 22 motherboard, cabinet, 8080 CPU, 4K RAM, 8800 interface card, $200. Cromemco 8K Bytesaver with PROM burner and 2708s, $100. Cromemco 7+ I/O, $100. Tarbell cassette interface, $75. Processor Tech. 3 parallel, 1 serial I/O, $80. All of above $500 cash. Joe Petro, 3503 Berkeley Pl. N.E., Albuquerque NM 87103.

Apple II software—cassette: 16K blackjack—multicolor card display, 2-player paddle input, full Las Vegas rules, opt., autoplay by computer, sound effects, documentation incl., $10. George W. Lee 18803 S. Christina Ave., Cerritos, CA 90701.

For Sale: Mits 88-ACR, 88-2SIO TTY, 8800A, 88-4MCS, 88-16MCS. ASR-33 TTY. 2 IBM 5440 hard disks. Must sell. High bidder takes any item. Michael Clark, R.D. #3, Nazareth PA 18064 (215) 759-6873.

TRS-80 Sort: in BASIC I, 4K min. Sorts recs in memory on 1 or 2 numeric fields in asc. or desc. seq. Input from tape, k.b. or both. Output to tape or video. Can be subroutine. $10 on tape w/doc. To: Software, Box 6153, Syracuse NY 13217.

SWTP 6800/1 with 12K, serial control interface, parallel interface, documentation, in good condition, $620. J. Wendel, 2 2nd St. NE, East Grand Forks MN 56721.

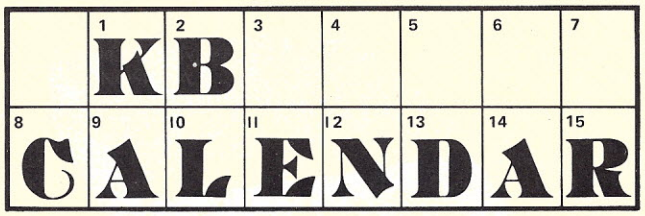
Struggling Artist/Programmer needs hardcopy graphics, digital or analog X-Y plotter. Write: Mitch Wade, 20221 Birch St., Santa Ana Heights CA 92707.

For Sale: North Star Software Special. Personal finance and budgeting package, $15. Memory test, $10, Diskopy, $10. Both for $15. Stock market analysis package, $10. Correspondence editor, $5. Mail list, $5. Special assortment disk, $10. Plus much more. Send blank disk or $5.25 for disk. Write for complete list. Herb Schildt, 1007 N. Division, Urbana IL 61801.

GE opto-isolators H11A2, all prime. 100% guaranteed. With spec. 2/$1., 100/$40. A. Khan, 2355 Burch Cir. N.E., Atlanta GA 30319.

CIRCLE CHESS instruction book by Alphonso, used in Circle Chess software development. $5, Stanonis, Box 63, Des Plaines IL 60017.

Poly & TRS-80 Software—New, Original. Send for complete list. Ted Carter, 902 Pinecrest, Richardson TX 75080. (214) 235-0915.



The following shows are coming up in '78:

Orlando	May 19-21
Paris	May 23-25
Atlanta	June 3-4
Anaheim	June 6-8
Dallas	June 17-18
Detroit	June 23-25
Wash DC	Jul 22-23
San Antonio	Aug 5-7
San Diego	Aug 22-24
Philadelphia	Aug 25-27
NYC	Sep 22-24
Houston	Sep 29-Oct 1
Dallas	Sep 29-Oct 1
Chicago (Benwill)	Oct 5-8
Chicago (Bunnell)	Oct 12-15
Seattle	Oct 21-22
Los Angeles	Nov 3-5

CORRECTIONS

Robert L. Smith of 2300 St. Francis Dr., Palo Alto CA 94303, writes:

"I have some information that may be of use to readers of the article, 'Super Terminal!' (March issue, p. 48), about the Burroughs/Friden 9350-2. There were some unidentified pins on Table 4 (and at least one pin in error). The identification should be as follows:

Pin No.	Function
24	SHIFT ENCODER #1
26	SHIFT ENCODER #2
27	BIT 6 OUT
28	PARITY BIT OUT
32	CONTROL BIT 6 OUT
33	CONTROL BIT 5 OUT
34	CONTROL PARITY BIT OUT
37	CONTROL BIT 7 OUT

Note that in Fig. 6, the missing pin is pin 27.

"It is not impossible to repair and modify the original boards, as I have done so, even before I obtained any original documentation. I did, however, have to generate a fair amount of documentation on my own.

"At least some of the ICs on the original circuit boards are apparently available from Raytheon. I have a limited supply of the various ICs (unused) if anyone is in need of them. I also have some used circuit boards and a fair amount of mechanical and electrical documentation for the 9350. However, I do not have any decent method for copying and distributing most of the documentation because of the large volume of the material."

Chris Kilgus of Phoenix AZ wrote to inform us that the ACIA in Fig. 1 of Don Gille's article "Tuned for Speed" (February issue, p. 59) is an MC 6850 rather than a 6820.

Our address was printed as Box 2485 in the "Mystery Program" in the April 1978 issue. It should be: Tom Rugg and Phil Feldman, PO Box 24815, Los Angeles CA 90024.

IT'S ABOUT TIME!

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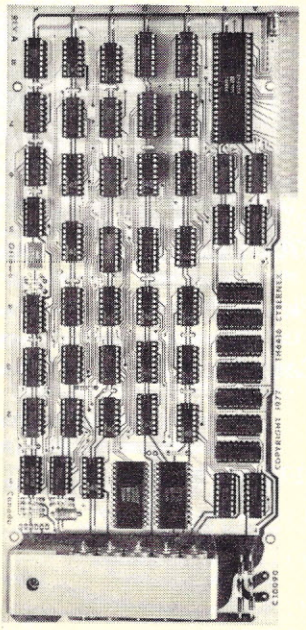

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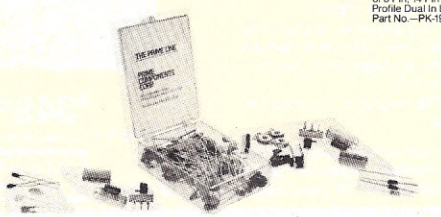

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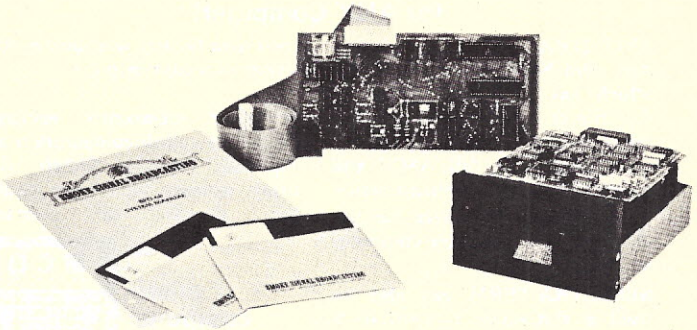

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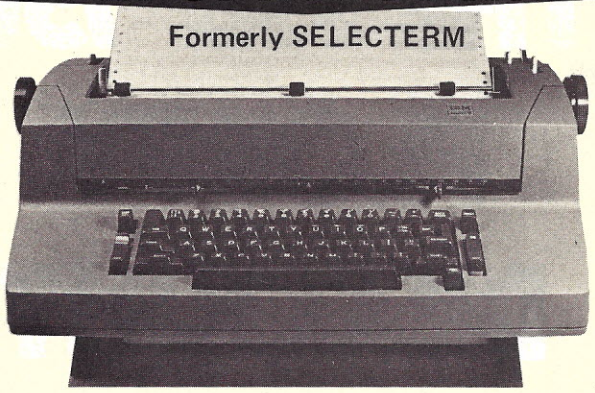

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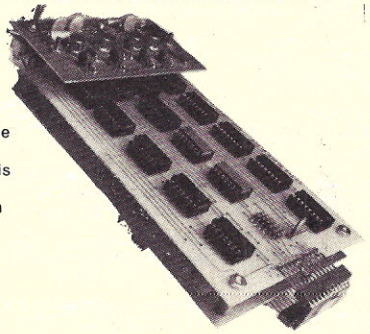

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7485N	.88	74LS162N	.91	LM747H/N	.62	CD4018	.94	MM5837	13.95		
7489N	2.00	74LS163N	.91	LM748N	.35	CD4019	.21	MM5838	3.00	**UART/FIFO**	
7490N	.43	74LS174N	.95	LM1303N	.82	CD4020	1.02	MM5839	4.00	AY5-1013	5.50
7492N	.43	74LS190N	1.06	LM1304	1.10	CD4021	1.02	MM5840	3.90	AY5-1014	7.50
7493N	.43	74LS221N	1.95	LM1305	1.27	CD4022	.86	MM5841	14.45		6.95
7495N	.69	74LS258N	.67	LM1307	2.00	CD4023	.21	MM5865	7.95	**PIN/DM**	
74100N	.90	74LS367N	.89	LM1310	2.75	CD4024	.75	CT7001	5.80	DM8577	2.90
74107N	.29			LM1458	.47	CD4025	.21	CT7002	8.95	8223	2.90
74121N	.49	**LINEAR**		LM1800	1.75	CD4026	1.51	CT7010	8.95	2716	36.00
74123N	.59	CA3045	.90	LM1812	7.50	CD4027	.36	CT7015	7.25		
74125N	.39	CA3046	.67	LM1889	3.00	CD4028	.79	MM5375AA/N	3.90	**CONNECTORS**	
74145N	.69	CA3081	1.80	LM2111	1.75	CD4029	1.02	MM5375AB/N	4.90	44 pin edge	2.00
74150N	.95	CA3082	1.90	LM2902	1.50	CD4030	.21	7205	16.50	100 pin edge	4.50
74151N	.69	CA3089	2.95	LM3900N	.60	CD4035	1.02	DS0026CN	3.75	100 pin edge WW	5.25
74154N	1.00	LM301AN/AH	.35	LM3905	1.75	CD4040	1.02	DS0056CN	3.75		
74157N	.69	LM305H	.87	LM3909N	.61	CD4042	.71	MM5314	2.50	**CRYSTALS**	
74161N	.87	LM307N	.35	MC1458V	.50	CD4043	.63			1 MHz	4.50
74162N	.87	LM308N	.89	NE540L	2.89	CD4044	.63	**IC SOCKETS**		2 MHz	4.50
74163N	.87	LM309H	1.15	NE550N	.65	CD4046	1.67	**Solder Tin Low Profile**		4 MHz	4.25
74174N	.96	LM309K	.95	NE555V	.43	CD4049	.36	**PIN 1UP PIN 1UP**		5 MHz	4.25
74175N	.90	LM311H/N	.99	NE556A	.79	CD4050	.36	8 15 24 36		10 MHz	4.25
74190N	1.15	LM317T/K	2.50	NE565A	1.00	CD4051	1.13	14 18 28 43		18 MHz	3.90
74192N	.87	LM318	1.35	NE566V	1.15	CD4060	1.42	16 20 36 58		20 MHz	3.90
74193N	.85	LM320K-5	1.20	NE567V	1.20	CD4066	.71	18 .27 40 .61		32 MHz	3.90
74221N	1.55	LM323K-5	6.95	78L05	.60	CD4068	.40	22 .35		32768 Hz	4.00
74298N	1.65	LM320K-12	1.35	78L08	.60	CD4069	.40	3 level wire wrap gold		1.8432 MHz	4.50
74365N	.66	LM320K-15	1.35	78L05	.70	CD4070	.40	14 pin .35 16 pin .39		2.0100 MHz	1.95
74366N	.66	LM320T-5	1.60	78M05	.85	CD4071	.21	2 level 14 pin ww .25		2.097152 MHz	7.75
74367N	.66	LM320T-8	1.60	75108	1.75	CD4072	.21	**MICROPROCESSOR**		2.4576 MHz	7.50
74LS00 TTL		LM320T-12	1.50	75491CN	.50	CD4073	.21	6800	24.50	3.2768 MHz	7.50
74LS00N	.25	LM320T-15	1.60	75492CN	.55	CD4075	.21	6800A with data	11.50	5.0688 MHz	4.50
74LS02N	.25	LM324N	1.15	75494CN	.89	CD4076	1.75	280	29.95	5.185 MHz	4.50
74LS03N	.25	LM339N	1.55	**A to D CONVERTER**		CD4078	.40	8212	3.50	5.7143 MHz	4.50
74LS05N	.25	LM340K-5	1.10	8038B	4.50	CD4081	.21	8214	8.00	6.5536 MHz	4.50
74LS08N	.25	LM340K-8	1.10	8700CJ	13.95	CD4082	.21	8216	3.85	14.31818 MHz	4.25
74LS10N	.25	LM340K-12	1.10	8701CN	22.00	CD4116	.47	8224	3.50	18.432 MHz	4.50
74LS13N	.40	LM340K-15	1.10	8750CJ	13.95	CD4490	5.50	8228	6.25	22.1184 MHz	4.50
74LS14N	.90	LM340K-24	1.10	LD130	9.95	CD4507	1.00				
74LS20N	.25	LM340T-5	1.10	9400CJ/VF	7.40	CD4536	4.25				
74LS22N	.25	LM340T-8	1.10	ICL7103	9.50	CD4510	1.02				

CD4511	.94		
CD4515	2.52		
CD4516	1.10		
CD4518	1.02		
CD4520	1.02		
CD4527	1.51		
CD4528	.79		
CD4553	5.75		
CD4566	2.25		
CD4583	4.50		
CD4585	1.10		
CD40192	3.00		
74C00	.28		
74C04	.33		
74C10	.28		
74C14	2.10		
74C20	.28		
74C30	.28		
74C48	2.95		
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74C76	1.40		
74C90	1.15		
74C93	1.40		
74C154	3.00		
74C160	1.44		
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74C192	2.40		
74C221	2.75		
74C905	3.00		
74C906	1.50		
74C914	1.95		
74C922	7.50		
74C923	7.50		
74C925	10.50		
74C926	10.50		
74C927	10.50		
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8095	.65		
8096	.65		
8097	.65		
8098	.65		
8T09	1.25		
8T10	4.50		
8T13	3.00		
8T20	5.50		
8T23	3.10		
8T24	3.50		
8T25	3.20		
8T26	1.69		
8T28	2.75		
8T97	1.69		
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RAM			
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2102AL-4	1.60		
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DL707 DL707R	CA	300	1.00
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DL750	CC	600	1.95
FND359	CC	357	.70
FND500 507	CC CA	500	1.35
FND503 510	CC CA	500	.90
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Video computer with games and graphics.

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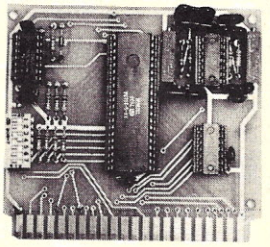
RS-232/TTY* INTERFACE NEW

Part no. 600

- Converts RS-232 to 20mA current loop, and 20mA current loop to RS-232
- Two separate circuits
- Requires +12 and -12 volts
- Board only $4.50, with parts $7.00

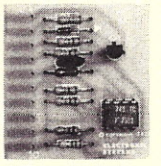


UART & BAUD RATE GENERATOR*

Part no. 101

- Converts serial to parallel and parallel to serial
- Low cost on board baud rate generator
- Baud rates: 110, 150, 300, 600, 1200, and 2400
- Low power drain +5 volts and -12 volts required
- TTL compatible
- All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity.
- All connections go to a 44 pin gold plated edge connector
- Board only $12.00; with parts $35.00

RS-232/TTL INTERFACE*



Part no. 232

- Converts TTL to RS-232, and converts RS-232 to TTL
- Two separate circuits
- Requires -12 and +12 volts
- All connections go to a 10 pin gold plated edge connector
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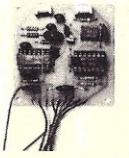
DC POWER SUPPLY*

Part no. 6085

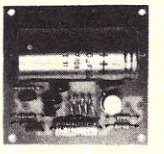
- Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp.
- Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps.
- Board only $12.50; with parts $42.50 excluding transformers



Part no. 111

TAPE INTERFACE*

- Play and record Kansas City Standard tapes
- Converts a low cost tape recorder to a digital recorder
- Works up to 1200 baud
- Digital in and out are TTL-serial
- Output of board connects to mic. in of recorder
- Earphone of recorder connects to input on board
- Requires +5 volts, low power drain
- Board $7.60; with parts $27.50
- No coils

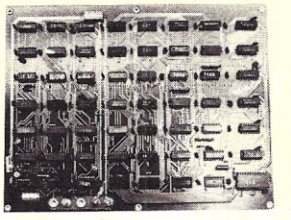


Part no. 107

RF MODULATOR*

- Converts video to AM modulated RF, Channels 2 or 3
- Power required is 12 volts AC C.T., or +5 volts DC
- Board $7.60; with parts $13.50

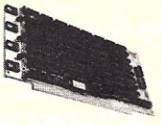
TELEVISION TYPEWRITER



Part no. 106

- Stand alone TVT
- 32 char/line, 16 lines, modifications for 64 char/line included
- Parallel ASCII (TTL) input
- Video output
- 1K on board memory
- Output for computer controlled curser
- Auto scroll
- Non-destructive curser
- Curser inputs: up, down, left, right, home, EOL, EOS
- Scroll up, down
- Requires +5 volts at 1.5 amps, and -12 volts at 30 mA
- All 7400, TTL chips
- Char. gen. 2513
- Upper case only
- Board only $39.00; with parts $145.00

8K STATIC RAM



Part no. 300

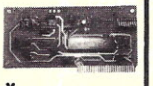
- 8K Altair bus memory
- Uses 2102 Static memory chips
- Memory protect
- Gold contacts
- Wait states
- On board regulator
- S-100 bus compatible
- Vector input option
- TRI state buffered
- Board only $22.50; with parts $160.00

TIDMA*

Part no. 112

- Tape Interface Direct Memory Access
- Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate.
- S-100 bus compatible
- Board only $35.00; with parts $110.00

Apple II Serial I/O Interface*



Part No. 2

- Baud rates up to 30,000
- Plugs into Apple Peripheral connector
- Low-current drain
- RS-232 Input and Output

SOFTWARE

- Input and Output routine from monitor or BASIC to teletype or other serial printer.
- Program for using an Apple II for a video or an intelligent terminal. Board only – $15.00; with parts – $42.00; assembled and tested – $62.00.

MODEM*

Part no. 109

- Type 103
- Full or half duplex
- Works up to 300 baud
- Originate or Answer
- No coils, only low cost components
- TTL input and output-serial
- Connect 8 ohm speaker and crystal mic. directly to board
- Uses XR FSK demodulator
- Requires +5 volts
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★ Uses 2114

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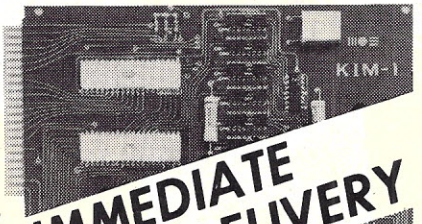

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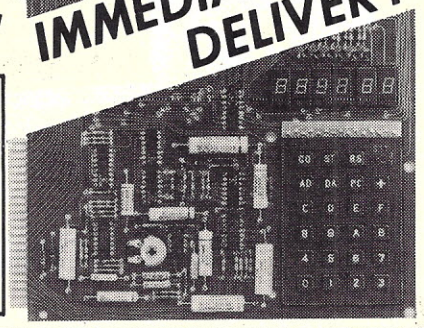

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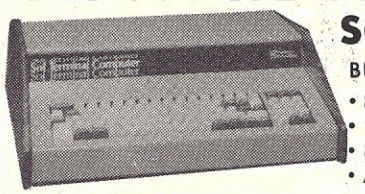

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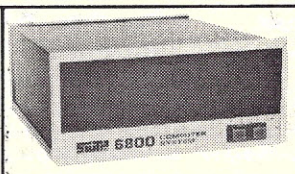

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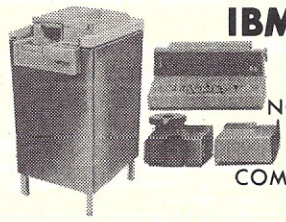

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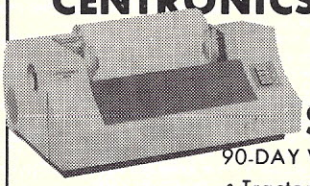

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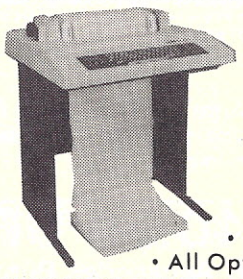

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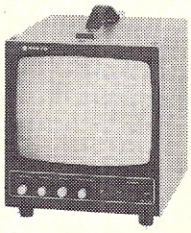

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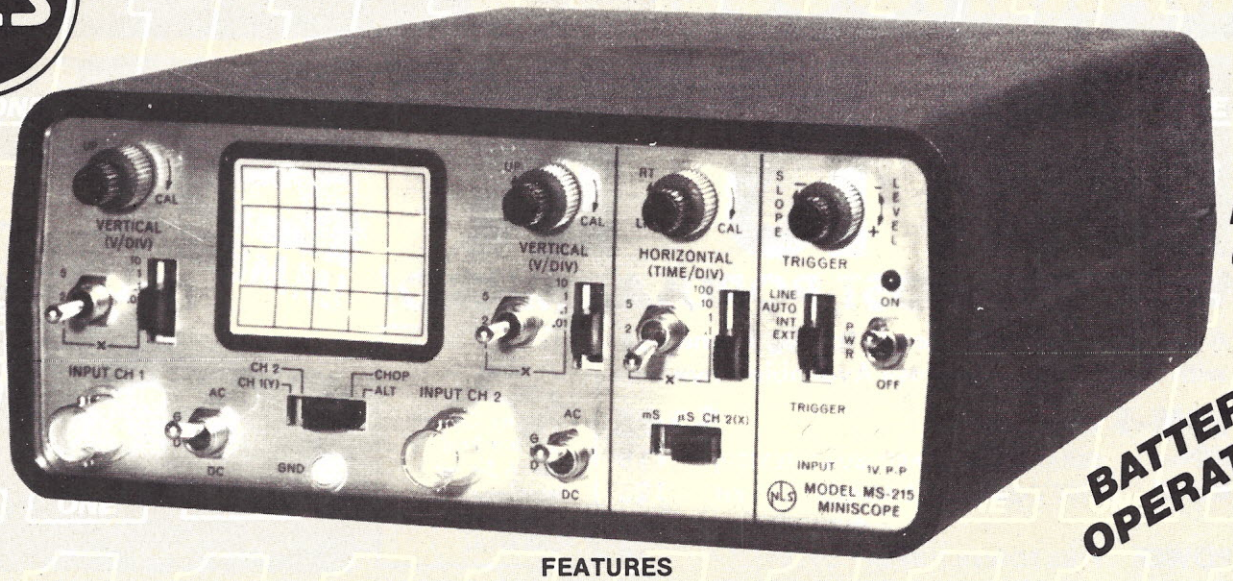

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- Weight is only 3 pounds.

From the originator of the Digital Voltmeter, Non-Linear Systems comes the MS-215 Miniscope. It is a fine electronic instrument with a great deal of measuring capability and excellent accuracy. Its design is modern, utilizing the latest in low-powered integrated circuits, and it is packaged into the smallest practical size. The instrument fits into many briefcases and tool boxes with room to spare.

Operating characteristics have been chosen so that the MS-215 will make all of the measurements needed in servicing most electronic equipment. It is field-portable so its use is not restricted to the bench.

SPECIFICATIONS:

Vertical
Mode: CH1, CH2, CH1 & CH2 (Chopped) & CH1 & CH2 (Alt.)
The Following Specifications apply to each channel

Y Axis
Verticle Input: 10mV/div to 50V in 12 Calibrated ranges, as follows:
x1-10mV/div to 10V/div in four ranges, each continuously variable.
x2-20mV/div to 20mV/div in four ranges, each continuously variable.
x5-50mV/div to 50mV/div in four ranges, each continuously vairiable.
Accuracy is 3%
Input Impedence: 1M ohm shunted by 50 pF.
Bandwidth: DC/DC to 15 Mhz ±6 db (DC to 8 Mhz ±3 db). AC, same as DC down to 3Hz.
Rise Time: Approximately 23 nS @ 1 division deflection.
Input Voltage: 250 maximum (DC and Peak AC).

Horizontal
Mode: Internal Time Base or External Horizontal, switch selectable. In the XY mode, vertical input is through CH1 and horizontal input is through CH2
Bandwidth: DC to 200 KHz (±3 db).
Coupling: AC, DC or ground, switch selectable. Low frequency point on AC is 3 Hz.
Input Impedence: 1Meg ohm shunted by 50 pF.
Deflection Factor: 10mV/div to 50V/div in 12 calibrated ranges. The ranges can be calibrated with the CH2 gain control
Input Voltage: 250V maximum (DC and Peak AC)
Time Base: **0.1uS/div to 0.5 Sec/div in 21' calibrated ranges, as follows:**
x1, uS-0.1uS/div to 100 uS/div. x2, uS-0.2uS/div to 200 uS/div.
x5, uS-0.5uS/div to 500 uS/div. x1, mS-0.1mS/div to 100 mS/div
x2, mS-0.2mS/div to 200 mS/div. x5, mS-0.5mS/div to 500 mS/div.
all in four ranges, each continuously variable. (Range increments ar .1, 1, 10, 100.) With vernier in full clockwise position, calibrated time measurements are possible. Accuracy is 3%.

Triggering
Internal: Sweep triggered from internal trigger source (In the dual trace modes, the internal trigger source is CH1).
Automatic: Trigger source is internal calibrater frequency. To be used if there is no other trigger source available to synchronize the sweep.
Line: Trigger is derived from line frequency when using the battery charger.
External: Controls function as for internal triggering (1 Megohm input impedence).
Slope: Selects sync to positive- or negative- going waveform.
Coupling: AC
Sensitivity: Less than 1 div for internal trigger and less than 1 volt for external trigger.
Level: Trigger Level control permits continuous adjustment of trigger point in all modes except Auto.
Internal Calibrater: A square-wave signal of 1 volt p-p ± 5% is provided. Frequency is approximately 1KHz.

Display
Graticule: 4x5 div, each division is 0.25 inch. Viewing area 1.1"Hx1.35"W
CRT: Bluish-white phospher, medium peristence. CRT uses low power filament for low battery drain. Instant on!

Power
On-Board Batteries: Three sealed, rechargeable lead acid "D" Cells
Operating Time: Typically 4 hours.
Charging Time Scope Operating: Will run indefinitely but not reach full charge.
Non-operating: Sixteen hours.
External Power: Battery charger 115 vac (220 vac on request). 50-400Hz, less than 15 watts.
Dimensions: 3.1"Hx6.4"Wx8.0"D.
Weight: Three pounds.

Environment
Operating Temperature: 0° to 40°C
Shock and Vibration: Designed to with stand normal shock and vibration encountered in commercial shipping and handling.

Accessories
Furnished: Tilt stand, battery charger, 2 input cables, and 3 miniature banana plugs.
Optional: Leather carrying case and probes
Warrranty: One year parts and labor. Made in the U.S.A.

MS-215 with Rechargeable Batteries and Charger $395.00

Leather Carrying Case

The leather case has 2 separate compartments. One to hold the scope, t other to hold the charger, probe, shoulder strap, etc. The case can be wo on the belt, or over the neck.

The snaps used on the case are "one way", thus accidental striking the case against an object will not undo the snaps or let it be pulled off yc belt.

41-140 ***$30.0***

Probes

10 to 1 probe with 10 megohm input.

Probe uses spring hook tip for sure connection. Compensation network located at the connector rather than at the probe, so as to keep size a weight to a minimum.

41-141 ***$24.5***

Deluxe Combination Probe

Switchable 10to1/1to1 probe with an assortment of probe tips to suit any situation.

41-3495 ***$34.95***

MS-15 Single Trace version of MS-215

$289.00

$40.00 OFF
On Any Accesories Purchased with **MS-215 MINISCOPE,** Just Send or Mention the **COUPON** and **Kilobaud** *Magazine*

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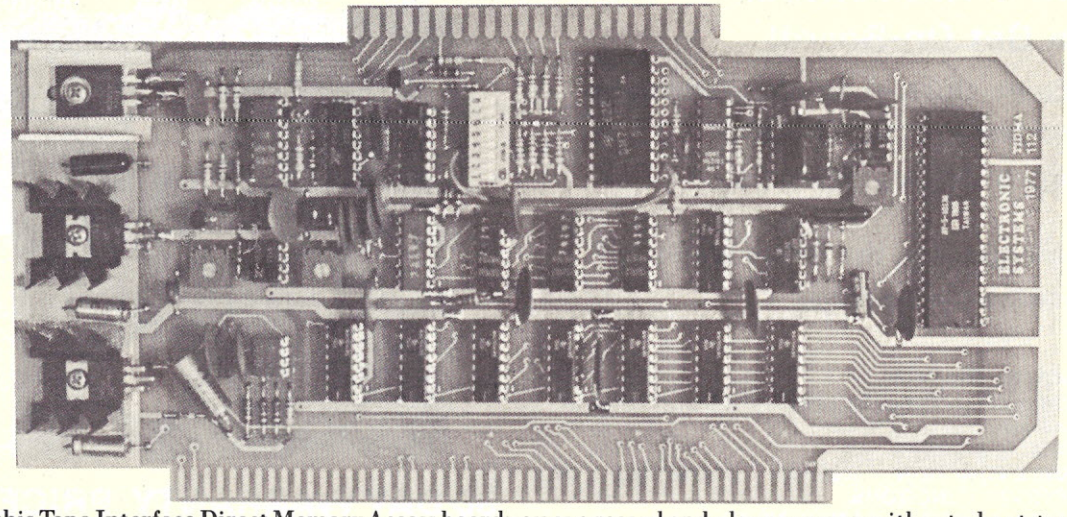
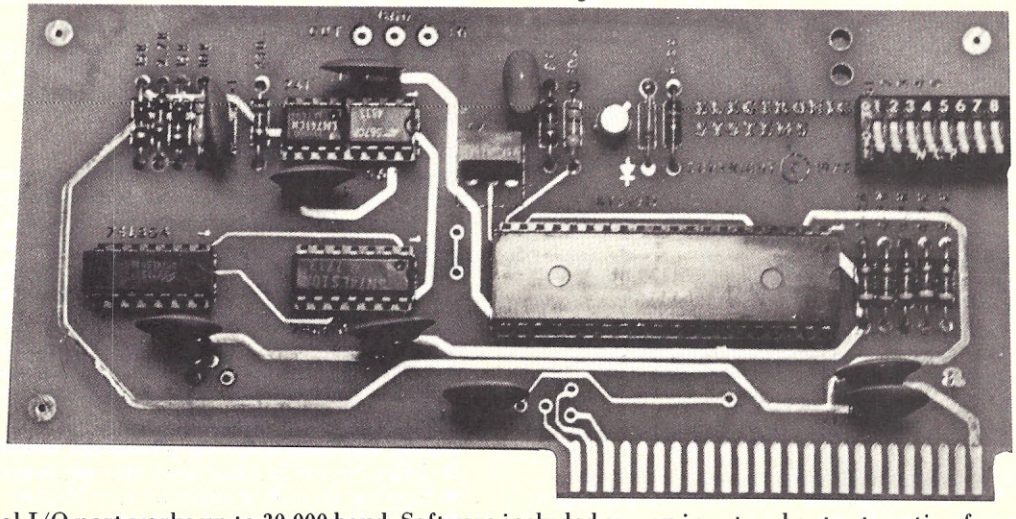
TIDMA



With this Tape Interface Direct Memory Access board you can record and play programs without a bootstrap loader (no prom). This can be up and running as fast as putting it in the socket. It takes complete control of the S-100 bus and reads or writes directly into the memory without the need for the microprocessor. It has an FSK encoder/decoder for direct connections to a low cost cassette recorder at 1200 baud, and inputs and outputs for direct connections to a digital recorder at any baud rate. This board is S-100 bus compatible.

Board only $35.00 Part No. 112; with parts $110.00 Part No. 112A

APPLE II SERIAL I/O INTERFACE



This serial I/O port works up to 30,000 baud. Software included are, an input and output routine from the Apple monitor or basic to a teletype or other serial printer. Also a program for using the Apple II for a video terminal or an intelligent terminal. It plugs into one of the Apple II peripheral connectors. It uses very low current. The input and output are RS-232.

Board only $15.00 Part No. 2; with parts $42.00 Part No. 2A. Assembled and tested $62.00 Part No. 2C.

To Order:

VISA master charge

Mention part number and description. For parts kits add "A" to part number. Shipping paid for orders accompanied by check, money order, or Master Charge, BankAmericard, or VISA number, expiration date and signature. Shipping charges added to C.O.D. orders. California residents add 6.5% for tax. Parts kits include sockets for all ICs, components, and circuit board. Documentation is included with all products. Dealer inquiries invited. 24 Hour Order Line: (408) 374-5984. Circuits designed by John Bell.

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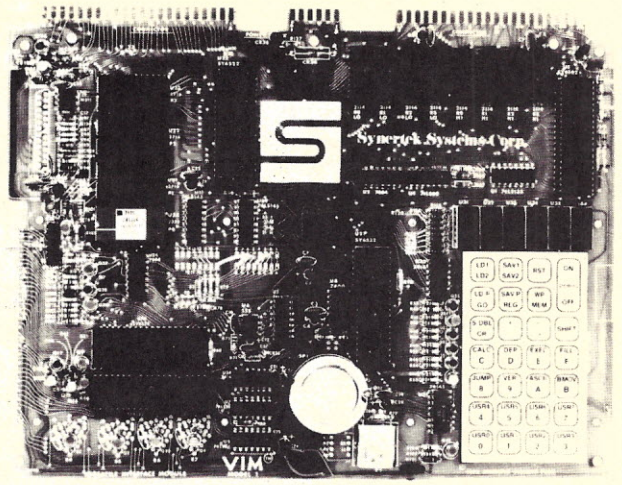
Thanks to you . .

Presents The All New VIM-1,6502 Based MICROCOMPUTER SYSTEM By Synertek Systems Corp.

The VIM-1 Has Arrived!
Time to Get On-Board!

Don't become stuck in an old technology. Master the latest, state-of-the-art Technology of Microprocessors.

Develop insight into the future trends of microprocessor technology.



VIM-1 Features Include:

- FULLY-ASSEMBLED AND COMPLETELY INTEGRATED SYSTEM that's ready-to-use.
- ALL IC'S ARE IN SOCKETS
- 28 DOUBLE-FUNCTION KEYPAD INCLUDING UP TO 24 "SPECIAL" FUNCTIONS
- EASY-TO-VIEW 6-DIGIT HEX LED DISPLAY
- KIM-1* HARDWARE COMPATIBILITY
- The powerful 6502 8-Bit MICROPROCESSOR whose advanced architectural features have made it one of the largest selling "micros" on the market today.
- THREE ON-BOARD PROGRAMMABLE INTERVAL TIMERS available to the user.
- 4K BYTE ROM RESIDENT MONITOR and Operating Programs.
- Single 5 Volt power supply is all that is required.
- 1K BYTES OF 2114 STATIC RAM onboard with sockets provided for immediate expansion to 4K bytes onboard, with total memory expansion to 65, 536 bytes
- USER PROM/ROM: The system is equipped with 3 PROM/ROM expansion sockets for 2316/2332 ROMs or 2716 EPROMs
- ENHANCED SOFTWARE with simplified user interface
- STANDARD INTERFACES INCLUDE:
  - — Audio Cassette Recorder Interface with Remote Control (Two modes: 135 Baud KIM-1* compatible, Hi-Speed 2400 Baud)
  - — Full duplex 20mA Teletype Interface
  - — System Expansion Bus Interface
  - — TV Controller Board Interface
  - — CRT Compatible Interface
- APPLICATION PORT: 15 Bi-directional TTL lines for user applications with expansion capability for added lines
- EXPANSION PORT FOR ADD-ON MODULES (51 I/O Lines included in the basic system)
- SEPARATE POWER SUPPLY connector for easy disconnect of the d-c power
- AUDIBLE RESPONSE KEYPAD

VIM-1 Manuals: The well organized documentation package is complete and easy-to-understand
VIM-1 CAN GROW AS YOU GROW. It's the system to BUILD-ON. Expansion features that are soon to be offered:

90 DAY WARRANTY PRICE $269.00

- TV Interface Card
- BASIC Interpreter
- Resident Assembler/Editor
- Port Expansion Kit
- RAM Expansion Kit

If You Like KIM* You Will Love VIM

VIM-1 PROVIDES YOU WITH ON-BOARD EXPANSION. The printed circuit board includes sockets to add additional ROM, PROM, RAM, or Peripheral Ports when you require them. VIM-1 doesn't require you to build up wire-wrap boards to use these options. VIM-1 option boards are merely plugged into the basic unit to give you the added capability you require. We have maintained KIM* hardware compatibility. Our boards will plug into any KIM* motherboard and card cage.

SUPER SOFTWARE

Synertek has enhanced KIM-1* software as well as hardware. The software has simplified the user interface. The basic VIM-1 system is programmed in machine language. For those users who want to develop in assembly language directly on VIM-1 the optional RESIDENT ASSEMBLER/EDITOR can be purchased and plugged into the ROM/PROM expansion sockets ALREADY PROVIDED.

Similarly, those users wishing to develop in a high level language can purchase VIM-1 BASIC as a nominally priced option. Monitor status is easily accessible, and the monitor gives the keypad user the same full functional capability of the TTY user.

**KIM is a product of MOS Technology.*

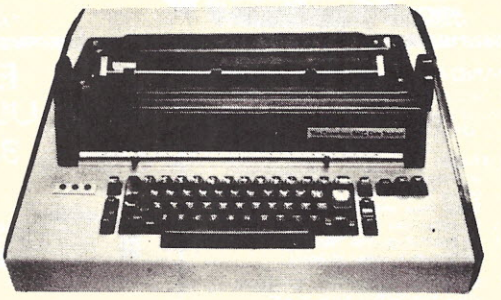
Other Software Enhancements Include:

- Write Protect of Selectable Memory Areas
- Decimal Point Prompting on Hex Display
- Break Function to Halt Program
- Programmable/Debug/On-Off (Prog. Single-Capabilities)
- Software Breakpoint Feature

Allow 2 to 4 Weeks for Delivery *Quantity Discounts Available Upon Request.*

SPECIAL OFFER: Commercial Duty Power Supply Designed For VIM-1 *Fully* EXPANDED: *Fully Enclosed, Regulated Over Voltage Protection, Fused, Grounded AC Cord, and a FULL TWO YEAR WARRANTY.*
PROVIDES:+ 5 V.D.C. @ 10 Amps. & ± 12 V.D.C. @ 1 AMP.
PRICE IF PURCHASED SEPARATELY **$150.00**
PRICED IF PURCHASED WITH VIM-1 **$ 95.00**

. . We're Growing!



HEAVY DUTY IBM 735 I/O SELECTRIC BASED TERMINAL
MECHANICS COMPLETELY REFURBISHED—
ALL NEW MICROPROCESSOR-BASED ELECTRONICS—
SWITCH SELECTABLE FOR *EITHER ASCII* OR *EBCDIC* OPERATION
PRICE: $895

WHAT YOU SHOULD KNOW BEFORE BUYING ANY STANDARD IBM SELECTRIC TERMINAL

- Carriage Return time is about 5 times longer than a standard terminal; therefore, you need to transmit up to 12 null or rubout characters after the standard CR/LF characters to allow enough time for the carriage return. This may require you to rewrite your computer's software. There are other characters which have similar problems such as Index, Tab, Backspace and Shift.
- The mechanics of the IBM Selectric limit the printing speed to a maximum of 14.9 characters per second, therefore it cannot run at 150 baud (15 characters/sec.)
- The standard baud rate for a Selectric is 134.5 and therefore cannot interface with a system having only the standard baud rates such as 110 or 150 without modifying or completely replacing the terminal's electronics.
- Some of the IBM Selectric terminals use a unique character ball and are *not* interchangeable with the standard typewriter ball. The balls for these are more expensive, harder to find, and do not have the font selection.
- The IBM Selectric's printer and keyboard are mechanically linked together and therefore, without sophisticated electronics, it cannot interface with a full-duplex system.
- The Selectric produces only 10 standard control codes versus 34 on a standard ASCII terminal.
- There are several IBM Selectric terminals around and *not all* have the heavy duty Selectric mechanism.

WHAT YOU SHOULD KNOW ABOUT THE IBM I/O SELECTRIC TERMINAL THAT WE ARE OFFERING

- *TWO* operating systems (switch selectable)

A. As a standard IBM terminal using EBCDIC Code at 134.5 Baud. So that it can be used with IBM equipment.

B. As a Full 7-bit ASCII terminal at 110 Baud. With the following features;

1. The terminal operates at 10 cps, but prints at 14.9 cps and has a 150 character buffer to compensate for the long carriage return time. Therefore there is no requirement to rewrite your computer's software.
2. It generates all 34 of the standard ASCII control codes.
3. Full or Half-duplex operation.
4. Generation of parity.
5. Two modes of operation:
   a. TTY Mode: Transmits only upper-case codes (for alpha characters only) like a standard TTY even if the shift key is not depressed.
   b. Typewriter Mode: Transmits both upper and lower-case codes, dependent upon the shift key being depressed or not.

- Has both RS-232 and 20 ma. Current Loop interfaces.
- Remote/Local switch, so it can be used as a typewriter or a terminal.
- Uses the standard IBM Selectric character ball.
- Has a 15" carriage for up to 132 characters per line.
- Platen feed.

ALLOW 6 TO 8 WEEKS FOR DELIVERY • PRICE INCLUDES FULL DOCUMENTATION • 30 DAY WARRANTY—PARTS AND LABOR

Terminals only, select: ☐Airfreight ☐Surface ***TERMINALS SHIPPED FREIGHT COLLECT—FOB Phoenix AZ***
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EXPANDABLE EPROM BOARD

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Allows You to Use Either 2708's For 16K of Eprom or 2716's For 32K of Eprom.

KIT FEATURES:

1. All Address Lines & Data Buffered
2. Quality Plated through P.C. Board Including Solder Mask and Silk Screen
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WE CAN SUPPLY 450As 2708's AT $11.95 WHEN PURCHASED WITH BOARD.

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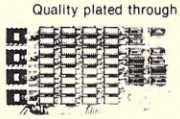
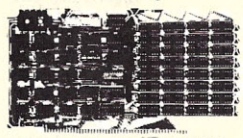
The Whole Works - $79.95

Full Buffered - on board regulated - reduced power consumption utilizing low power 21L02-1 500ns RAMS - Sockets provided for all IC's. Quality plated through PC board.



*Add $10.00 for 250ns RAM operation.

EXPANDORAM
THE ULTIMATE RAM BOARD
32K FOR $475.00



32K MODEL	
8K	$151.00
16K	259.00
24K	367.00
32K	475.00

64K MODEL	
16K	$281.00
32K	519.00
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THE 32K VERSION USES THE MOSTEK MK4115 RAM AND HAS 8K BOUNDARIES AND PROTECTION & UTILIZES DIP SWITCHES. P. C. BOARD COMES WITH SOCKETS FOR 32K OPERATION

BUY A S100 COMPATIBLE RAM BOARD AND UPGRADE THE SAME BOARD TO A MAXIMUM OF 65K MEMORY IN STEPS OF EITHER 8K OR 16K AT YOUR OPTION BY MERELY PURCHASING MORE RAM CHIPS FROM SD COMPUTER PRODUCTS.

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- MEMORY ACCESS TIME IS 375 ns
- MEMORY CYCLE TIME IS 500 ns
- POWER REQUIREMENTS ARE:
  - 8 VDC 400 MA DC
  - 18 VDC 400 MA DC
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- ON BOARD INVISIBLE REFRESH
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- CONTROL, DATA & ADDRESS INPUTS UTILIZE LOW POWER SCHOTTKY DEVICES
- DESIGNED TO WORK WITH Z-80, 8080, 8085, CPU's

ADD $50.00 TO ABOVE PRICES FOR FULLY ASSEMBLED AND TESTED BOARDS

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Features: Play and record K.C. Standard 2400/1200 Hz tapes, 300 Baud, TTL I/O Compatible, Phase Lock Loop, Both 22 Pin Connector and 8 Pin Molex Connector. Comes partially assembled. Oscillator and phase lock loop pre-tuned to K.C. Standard. Selector switch sends cassette data or auxiliary input data to microprocessor. LED indicates logic 1 level.

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FULLY ASSEMBLED AND TESTED. NOT A KIT.

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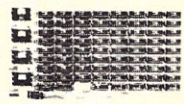
*Add $30.00 for 250ns RAM operation



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Complete Kit $139.

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"VERSAFLOPPY"™ KIT
THE VERSATILE FLOPPY DISK CONTROLLER
ONLY $149.00

FEATURES: IBM 3740 Soft Sectored Compatible. S-100 BUS Compatible for Z-80 or 8080. Controls up to 4 Drives (single or double sided). Directly controls the following drives:

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34 Pin Connector for Mini Floppy. 50 Pin Connector for Standard Floppy. Operates with modified CP/M operating system and C-Basic Comptler. The new "Versafloppy" from S.D. Computer Products provides complete control for many of the available Floppy Disk Drives, Both Mini and Full Size. FD1771B-1 Single Density Controller Chip, Listings for Control Software are included in price.

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Z80 STARTER KIT
LEARN COMPUTERS FROM THE START!

SIMPLE, STEP BY STEP LEARNING. CONSTRUCTION, PROGRAMMING, OPERATION, MEMORIES, INTERFACING, COMPUTING, AND CONTROLLING WITH AUDIO CASSETTE INTERFACE CAPABILITIES.

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Features: Powerful Z80 CPU with 158 instructions • 1024 Bytes (Expandable to 2048 Bytes ON BOARD) of RAM • 2 Bi-Directional Input/Output Ports with Handshaking • Kansas City Standard Audio Cassette Interface for Program Storage • Hexadecimal Keyboard and Display • Wirewrap area for custom circuitry • S-100 Connector on board for Memory and I/O Expansion • 2716/2758 PROM Programmer • "Z-BUG" Monitor ROM (Including: Memory, Port and Register Examine and Change Commands; Breakpoints; Single Step Capability; Audio Tape Load and Dump; Execute user program Commands.)

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$349.00

FEATURES:

- No Front Panel Needed
- Z-80 CPU (2 or 4 MHZ)
- 1K RAM
- 4 ROM/PROM Sockets for 4K/8K of Memory
- SYNCHRONOUS/ASYNCHRONOUS Serial I/O with RS-232 and Current Loop Interface and Software
- Programmable Baud Rate
- Parallel Input Port
- Parallel Output Port
- 4 Channel Timer/Counter
- 4 Vectored Interrupts

O.E.M. SPECIAL

ASK ABOUT SPECIAL O.E.M. DISCOUNTS ON THE S.D. "COMPATIBLE SET."

SBC-100 — SINGLE BOARD COMPUTER	$349.00
VERSAFLOPPY™ — FLOPPY DISK CONTROLLER	$149.00
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EACH KIT IF PURCHASED SEPARATELY TOTAL . . $973.00

ORDER ALL 3 KITS TOGETHER FOR

$899.00

This Powerful Threesome Operates Together to Form A Complete Computer for Your System.

Z-80 Programming Manual — IN DEPTH DETAIL OF THE Z-80 CPU MICRO-COMPUTER — **S. D. SALES SPECIAL $9.95**

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S.D. NOW HAS SOFTWARE FOR IT'S CUSTOMERS

CP/M® DISK OPERATING SYSTEM . . . $99.95

CP/M is a powerful disk operating system which has become an industry standard. It is compatible with several disk based FORTRAN and BASICS. This package includes a CP/M diskette (mini or full size) adapted for S.D.'s SBC-100/VERSAFLOPPY EXPANDORAM board set. Complete documentation is included. (® CP/M is a registered trademark of Digital Research Corp., Pacific Grove, CA.

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Runs on ANY CP/M based disk system. Assembles the official Zilog-Mostek Mnemonics. Contains extensive set of pseudo-ops. Available on mini or full size diskette.

VERSAFLOPPY™ CONTROL FIRMWARE . . . $24.95

Provides control for VERSAFLOPPY and boots up CP/M. This runs on Z-80, 8080 or 8085 based computers. Available in 2708 or 2758 prom.

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Powerful monitor for SBC-100 single board computers. Includes all VERSAFLOPPY control firmware. Comes in 2716 prom. Available in 4-6 weeks.

VERSAFLOPPY DIAGNOSTIC PROGRAM . . . $24.95

Provides routines which are helpful in checking out a disk based system Available in 2708 or 2758 prom.

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8214 — P.I.C.	12.95
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8224 — Clock Gen.	4.95
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PIO for Z—80	14.95
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8228 Sys. Controller	8.20
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8255 prog. prep. interface	13.50
8820 Dual Line Recr	1.75
8830 Dual Line Dr.	1.75
2513 Char. Gen.	7.50
8838 Quad Bus. Recvr.	2.00
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8T97-Hex Tri-State Buffer	1.25
1488/1489 RS232	1.50
TR 1602B Uart	3.95
TR 1863 Uart	8.50
FD 1771B-1	39.95

CMOS

4001	19	4029	99
4002	19	4042	69
4011	19	4047	1.50
4013	32	4049	35
4016	32	4069	23
4017	95	4071	19
4020	97	4076	97
4022	97	14518	1.10
4024	75	14528	85
4027	39	14529	85

SUPER FLOPPY SPECIAL

S. D. SALES' VERSAFLOPPY S-100 CONTROLLER BOARD PLUS SHUGART SA 400 FLOPPY DISK DRIVE INCLUDING CABLE FOR ONLY

$479.00

CALL IN YOUR BANKAMERICARD (VISA) OR MASTER CHARGE ORDER IN ON OUR CONTINENTAL TOLL FREE WATTS LINE:

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Texas Residents Call Collect:

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DEALER INQUIRIES INVITED!

(All prices subject to change without prior notice.)

NO COD's. TEXAS RESIDENTS ADD 5% SALES TAX. ADD 5% OF ORDER FOR POSTAGE & HANDLING . ORDERS UNDER $10. ADD 75c HANDLING.FOREIGN ORDERS — U. S. FUNDS ONLY!

MS-15 MINISCOPE $289.00 MS-15 MINISCOPE

NLS MS-15 MINISCOPE $289.00 NLS MS-15 MINISCOPE $289.00 NLS MS-15 MINISCOPE $289.00 NLS MS-15 MINISCOPE $289.00 NLS

SC-5 With Rechargeable Batteries & Charger Unit $89

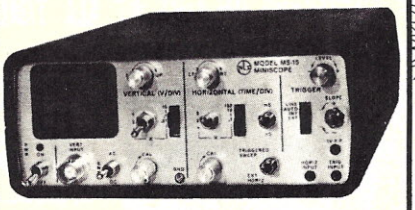
FM-7 With Rechargeable Batteries & Charger Unit $195

Features Include: • By using the new NLS SC-5 Prescaler, the range of the FM-7 Frequency Meter, which is 10 Hz to 60 MHz, may be extended to 512 MHz (the upper VHF & UHF frequency bands). • The FM-7 utilizes an LED readout, providing 7-digit resolution. • The FM-7 can be calibrated to an accuracy of 0.00001%. • The SC-5 is accurate to one part per million. • Each unit has 30 millivolts sensitivity, is battery powered and has a charger unit included. • Dimensions of each are 1.9" H x 2.7" W x 3.9" D. • The units may be obtained separately or as a "Frequency Duo." • Parts & Labor guaranteed 1 year.

Tilt stand option. . . . . $ 3.50
Leather case $16.00

MS-15 MINISCOPE $289

With Rechargeable Batteries & Charger Unit



- 15 megahertz bandwidth.
- External and internal trigger.
- Time base — .1 microsec. to 0.5 Sec/div - 21 settings ±3%.
- Battery or line operation.
- Automatic & line sync modes.
- Power consumption < 15 watts.
- Vertical Gain — .01 to 50 V/div - 12 settings ±3%.
- Viewing area 1.1" x 1.35".
- Case size 2.7"H x 6.4"W x 7.5"D, 3 pounds.
- Parts & Labor guaranteed 1 year
- 10 to 1, 10 meg probe $24.50
- Leather carrying case $30.00

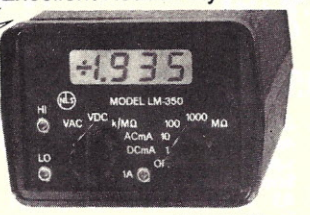
● MS-215 Dual Trace Version of MS-15 $395.00

PROBE 1¢ with the purchase of SCOPE and the MENTION of this MAGAZINE

NEW VOLKSMETERS!

With LCD Display— Excellent Readability in Direct Sunlight!

NEW



1% LM-300 Full three digits $99.50*

0.5% LM-350 3½ digits $125.00*

FEATURES

- Measures DC volts, AC volts, ohms and current.
- Automatic polarity, decimal and overload indication.
- No zero adjustment and no full scale ohms adjust.
- Large LCD display for easy reading without interpolation.
- Size: 1.9" H x 2.7" W x 4.0" D.
- Parts and labor guaranteed for one year.

SPECIAL!!

Batteries & Charger: $1.00 with the purchase of Meter and the mention of this magazine.

SPECIFICATIONS

MODE	RANGE	ACCURACY LM-300	ACCURACY LM-350	RESOLUTION	INPUT RESISTANCE	TEST CURRENT
VOLTS DC*	1 10 100 1000	±1% Reading†	±0.5% Reading†	1 mV 10 mV 100 mV 1 V	10 MΩ	
VOLTS AC*	1 10 100 1000	±1% Reading† 50-400 Hz	±0.7% Reading† 50-400 Hz	1 mV 10 mV 100 mV 1 V	10 MΩ, 20 pF	
KILOHMS**	1 10 100 1000 10000	±1% Reading†	±0.5% Reading†	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ		1 mA 100 µA 10 µA 1 µA 100 nA
CURRENT	1 mA 10 mA 100 mA 1 A	±2% Reading†	±2% Reading†	1 µA 10 µA 100 µA 1 mA	1 kΩ 100 Ω 10 Ω 1 Ω	

* 1000 vdc or peak ac maximum any range. †±2 Digits
**Test Voltage (Ohms) 1 vdc Full Scale - LM-300; 2 vdc Full Scale - LM-350
LM-350 has 100% over-range - full scale readings are 1.999, 19.99, etc.

Tilt Stand Option, add	$3.50
Leather Case	$16.00
3AA NiCad Batts. & Charger	$12.00

Standard AA-size batteries provide up to 20 hours of operation. Rechargeable NiCad batteries and charger unit available as optional equipment. *Batteries not included.

LEDU MG 10A List $72.00

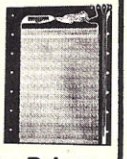
Perfectly balanced, fluorescent lighting with precision magnifier lens. For prof'l, techn'l & hobbist. Has die cast protective shade, inst. start 3 diopter lens. 42" reach. $44.95

with T-9 fluorescent lamp (required) $49.95
colors: Gray or Black
Chocolate Brown
2 choices please

$44.95 SPECIAL

8803 MOTHER BOARD FOR $100 BUS MICRO-COMPUTERS

Vector



- Kit includes 12 tantalum capacitors for +5, +12. —12 buses and insulated mounting spacers.
- Wiring side shown. Component side bare epoxy glass with white markings for component locations.
- G10 epoxy glass board with 2 ounce copper, solder plated and .038 diameter holes for leads.
- Solder mask with solder windows on etched circuits to avoid accidental short circuits.
- Mounts 11 receptacles with 100 contacts (2 rows) on .125 centers with .250 row spacing. Vector part number R681-2, or mounts 10 receptacles plus interconnections to smaller mother board for expansion.
- Includes etched circuits and instructions for option of active, pull-up, or floating terminations.
- Large buses: +5V and GND (10 AMPS), ±12V or 16V (7 AMPS). Current ratings are per MIL-STD-275 with 10°C rise.
- Fits in Vector-pak enclosures.
- Fits in IMSAI 8080 microcomputer as expander board.

Price: $29.50

Vector Plugboards

8800V

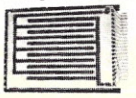
Universal Microcomputer/processor plugboard, use with S-100 bus. Complete with heat sink & hardware. 5.3" x 10" x 1/16"

1-4	5-9	10-24
$19.95	$17.95	$15.96

8801-1

Same as 8800V except plain; less power buses & heat sink.

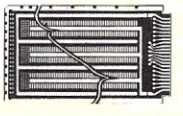
1-4	5-9	10-24
$14.95	$13.46	$11.96



3682 9.6" x 4.5" $10.97

3682-2 6.5" x 4.5" $9.81

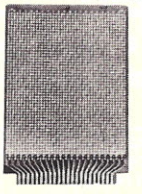
Hi-Density Dual-In-Line Plugboard for Wire Wrap with Power & Grd. Bus Epoxy Glass 1/16" 44 pin con. spaced .156



3677 9.6" x 4.5" $10.90

3677-2 6.5" x 4.5" $9.74

Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156



3662 6.5" x 4.5" $7.65

3662-2 9.6" x 4.5" $11.45

P pattern plugboards for IC's Epoxy Glass 1/16" 44 pin con. spaced .156

R644 P.C. recepticle 22/44 cont. .156 ctrs. pierced solder eyelets tails gold **$2.95**

R644-3 P.C. recepticle 22/44 cont. .156 ctrs. Wire Wrap tails gold . . **$4.49**

S-100 Bus P.C. Edge Connectors

R681 DIP solder tails on .140" spaced rows for ALTAIR mother boards. Fits .042" dia. holes, gold **$7.35**

R681-1 .025" sq., 3 wrap lengths posts (.62 long) on .250 spaced rows, gold **$5.00**

R681-2 .025" sq., 1 wrap length posts (.22 long) on .250 spaced rows for wrapping or DIP solder for IMSAI mother boards, gold **$5.85**

R681-3 pierced solder eyelet tails, gold **$7.35**

1/16 Vector BOARD

.042 dia holes on 0.1 spacing for IC's

Phenolic

PART NO.	SIZE	PRICE
64P44-062XXP	4.5 x 6.5"	$ 1.49
169P44-062XXP	4.5 x 17"	$ 3.51

Epoxy Glass

PART NO.	SIZE	PRICE
64P44-062	4.5 x 6.5"	$ 1.70
84P44-062	4.5 x 8.5"	$ 2.10
169P44-062	4.5 x 17"	$ 4.30
169P84-062	8.5 x 17"	$ 6.39

SLIT-N-WRAP

Wraps insulated wire on .025" square posts **FOUR TIMES FASTER** than regular manual wrap-post tools

P180 with two 100' spools of 28 ga. wire **$24.50**

P160-4T includes charger, wire **$75.00**

Vector

NO PRE-STRIPPING* NO PRE-CUTTING* SPOOL-FED WIRE*

*The spooled wire passes through the tool past a slitting edge next to the wrap post. A narrow longitudinal cut is made in the insulation where it presses the square post corner; the bared copper is indented by the sharp edge. (7 turns = 28 contacts)

Insulation is slit where wrapped but not between terminal posts when led straight out of the tool.

"Daisy-chain" runs Reliable and easy to use Manual or power operation

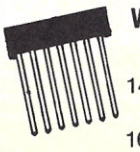
SLIT-N-WRAP WIRE NO. 28 GAGE INSULATED WIRE, 100' SPOOLS $2.25 Package

W28-2-A-Pkg. 3, Green W28-2-B-Pkg. 3, Red W28-2-C-Pkg. 3, Clear W28-2-D-Pkg. 3, Blue

2708 8K 450 ns EPROM FACTORY PRIME

$10.00 EA. 25 + Call For Price

14 & 16 PIN 3 LEVEL WIRE WRAP SOCKETS



14-T3 100 for **$30.00**

16-T3 100 for **$30.00**

50 of ea. for **$32.00**

ACE • All-Circuit Evaluator

for fast, solderless, plug-in circuit building and testing

Model 236

Just plug in any components with leads to .032" dia. Interconnect with solid wire up to 20 ga. Assembled models too!

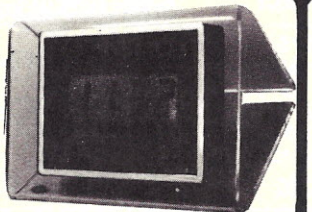
ACE Model No.	Tie Points	DIP Capacity	No. Buses	No. Posts	Board Size (Inches)	Price Each
200-K (kit)	728	8 (16's)	2	2	4-9/16 x 5-9/16	$18.95
208 (assem.)	872	8 (16's)	8	2	4-9/16 x 5-9/16	28.95
201-K (kit)	1032	12 (14's)	2	2	16 x 7	24.95
212 (assem.)	1224	12 (14's)	8	2	4-9/16 x 7	34.95
216 (assem.)	1760	18 (14's)	10	2	6-1/2 x 7-1/8	46.95
227 (assem.)	2712	27 (14's)	28	4	8 x 9-1/4	59.95
236 (assem.)	3648	36 (14's)	36	4	10-1/4 x 9-1/4	79.95

Gold-anodized aluminum base/ground, non-corrosive nickel-silver terminals; 4 rubber feet.

SALE

LIQUID CRYSTAL DIGITAL CLOCK-CALENDAR

- For Auto, Home, Office
- Small in size (2x2½x½)
- Push button for seconds release for date.
- Clocks mount anywhere with either 3M double-sided tape or VELCRO, included.
- 2 MODELS AVAILABLE: LCD-101, portable model runs on self-contained batteries for better than a year. LCD-102, runs on 12 Volt system and is backlighted.
- LCD-101 or LCD-102 your choice. . . . . **$34.95** ea.
- Clear desk stand for **$2.00**

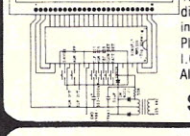


3 LEVEL GOLD WIRE WRAP SOCKETS

	1-24	25-49	50-99
8 pin	.47	.42	.37
10 pin	.45	.41	.37
14 pin	.39	.38	.37
16 pin	.43	.42	.40
18 pin	.75	.68	.62
20 pin	**.84**	**.77**	**.71**
22 pin	1.00	.97	.95
24 pin	1.00	.94	.75
28 pin	1.09	.98	.84
36 pin	1.59	1.45	1.30
40 pin	1.49	1.39	1.29

MICRO-KLIP for .042 dia. holes (all boards on this page)

T42-1 pkg. 100 **$ 1.50**
T42-1 pkg. 1000 . . . . . **$11.00**
P-149 hand installing tool . . . . . **$ 2.03**



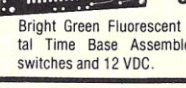
.8" LED ALARM CLOCK

12 hr. LED Alarm Clock uses 3½ digit .8" LED Display with AM/PM indicators and colons. Direct drive. PIN to PIN interface with **$1998A** I.C. Just add switches, AC Supply, Alarm. Display and I.C. only.

$7.95 or 2/$15.00

1

Price Breakthrough! $17.95



MA1003 CAR CLOCK

Bright Green Fluorescent Display Crystal Time Base Assembled, just add switches and 12 VDC.

SPECIAL

14CS2 100 for $14.00
16CS2 100 for $16.00
14 pin CS2 10 for $2.00
16 pin CS2 8 for $2.00

These low cost DIP sockets will accept both standard width plugs and chips.

For use with chips, the sockets offer a low profile height of only .125" above the board. These sockets are end stackable.

Vector WRAP POST

for .042 dia. holes (all boards on this page)

T-44 pkg. 100 . . **$ 2.28**
T-44 pkg. 1000. . . . . **$14.00**
A-13 hand installing tool . . . . . **$ 2.80**

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Send for our latest brochure. **phone orders welcome (213) 893-8202** OEM and Institutional inquiries invited.

24 PIN DIP PLUGS WITH COVERS

3 / $1.00
40 / $10.00

NLS MS-15 MINISCOPE $289.00 NLS MS-15 MINISCOPE $289.00 NLS MS-15 MINISCOPE $289.00 NLS MS-15

New!

16K E-PROM CARD

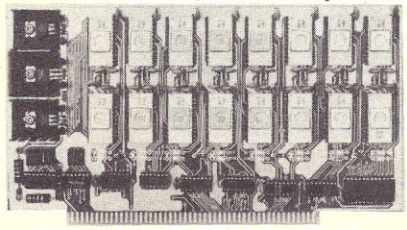
IMAGINE HAVING 16K OF SOFTWARE ON LINE AT ALL TIME!

S-100 (Imsai/Altair) Buss Compatible!

KIT FEATURES:

1. Double sided PC board with solder mask and silk screen and gold plated contact fingers.
2. Selectable wait states.
3. All address lines & data lines buffered!
4. All sockets included.
5. On card regulators.

KIT INCLUDES ALL PARTS AND SOCKETS (except 2708's). Add $25. for assembled and tested.



PRICE CUT!

$57.50 kit

WAS $69.95

SPECIAL OFFER:

Our 2708's (450NS) are $12.95 when purchased with above kit.

Fully Static!

ADD $20 FOR 250NS

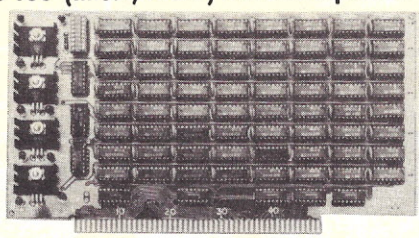
8K LOW POWER RAM KIT-$149.00

S-100 (Imsai/Altair) Buss Compatible!

KIT FEATURES:

1. Doubled sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included.
3. Fully buffered on all address and data lines.
4. Phantom is jumper selectable to pin 67.
5. FOUR 7805 regulators are provided on card.

(450NS)



USES 21L02 RAM'S!

2 KITS FOR $279

Fully Assembled & Burned In $179.00

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Low Profile Socket Set 13.50

Support IC's (TTL & Regulators) $9.75

Bypass CAP's (Disc & Tantalums) $4.50

MOTOROLA QUAD OP - AMP
MC 3401. PIN FOR PIN SUB. FOR POPULAR LM 3900.
3 FOR $1

ALARM CLOCK CHIP
N.S. MM5375AA. Six Digits. With full Data. **New!**
$1.95 each

FULL WAVE BRIDGE
4 AMP. 200 PIV.
69¢ 10 FOR $5.75

NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

MOTOROLA 7805R VOLTAGE REGULATOR
Same as standard 7805 except 750 MA output. TO–220. 5VDC output.
44c each or 10 for $3.95

450 NS! 2708 EPROMS
Now full speed! Prime new units from a major U.S. Mfg. 450 N.S. Access time. 1K x 8. Equiv. to 4-1702 A's in one package.
$15.75 ea. 4 FOR $50.00

COMPUTER MFG. MAKES $500,000.00 GOOF!

MOTOROLA **4K RAM CHIPS — 99¢** EACH **22 PIN DIP**

A major U.S. computer mfg. installed thousands of these 4K Motorola RAM's on the wrong boards and had to remove them. All parts were then tested, and met **FULL SPECS!** If you don't mind a little solder on the leads, then this is the best memory buy in the world. Arranged as 4096 x 1 Bits. 470 NS.
The Motorola 6605 is one of the easiest dynamic RAM's to use since it DOES NOT require multiplexed addresses as do most other 4K's such as the 4096 or 4027.
A complete memory board design using the 6605 is outlined in the Motorola M6800 Applications Manual starting on page 4-70.

99¢ EACH (WITH DATA SHEET) LOOK!

MCM6605 **FOR $6.95 YOU GET AS MUCH STORAGE AS IN 32 - 2102's!** **8 FOR $6.95** 4096 BYTES OF RAM!

FULLY GUARANTEED! **SURPLUS BUY OF THE DECADE!!!**

4K STATIC RAM'S
2114. The new industry standard. Arranged as 1K x4. Equivalent to 4-21 L02's in 1 package! 18 pin DIP. 2 chips give 1Kx8.
2/$24. 8/$85.

OPCOA LED READOUT
SLA-1. Common Anode. .33 inch character size. The original high efficiency LED display. **75c ea.**
4 FOR $2.50

Z-80 PROGRAMMING MANUAL
By Mostek, The major Z-80 second source. The most detailed explanation ever on the working of the Z-80 CPU CHIPS. At least one full page on each of the 158 Z-80 instructions. A MUST reference manual for any user of the Z-80. 300 pages. Just off the press. **$12.95**

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Fully static. Standard Power. The mostpopular RAM for microprocessors. We made a huge surplus buy, but there will be NO MORE WHEN THESE ARE GONE!

Part #21FO2-4 450 N.S. FAST!

8 FOR $6.95 32 FOR $25

HEAVY DUTY!
Full Wave Bridge
25AMP 50PIV
$1.25

Tantalum Capacitors
1 MFD. .35V. By Kemet. Axial Lead. Best Value! **10/$1.**

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N.S. MM5313. Features BOTH 7 segment and BCD outputs. 28 Pin DIP. **$4.95 with Data**

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SC146D. House no. To-220 case. Rated 10 amps 400PIV.
75c ea. 3/$2.

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74LS00 — 33c	74LS74 — 49c
74LS02 — 35c	74LS90 — 69c
74LS04 — 35c	74LS138—89c
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74LS10 — 33c	74LS175—1.10
74LS20 — 33c	74LS367—75c
74LS73 — 49c	74LS368—85c

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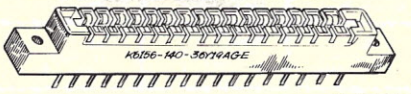
MALLORY ELECTROLYTIC FILTER CAPACITOR

1500 MFD. 16 WVDC.
Radial Leads. Factory Fresh!

3 FOR $1 **10 FOR $2.95**

Perfect for Power Supplies!
Small Size: 1¼ x ⅝ Inches.

PC BOARD EDGE CONNECTORS



75¢ **4 FOR $2.50**

36 Pin. Gold Plated. Solder Tail. .156 IN. Spacing. Double Rows of 18 Pins. For standard thickness (.062) PC Boards Major U.S. Mfg.

FAIRCHILD JUMBO RED LED'S

#FLV 110. Same style as used on IMSAI front panels. Super prime new units.

5 FOR $1
100 FOR $17.50

Telephone Eqmt. Component Board

Production over-run. Super good assortment of parts, all easily removed. Has four 47 MFD - 35V Tantalums plus 7 other asst. tantalums. Also includes 7 assorted transistors, 5 pot-core style variable inductors, over 30 assorted resistors, 1 transformer, and 5 diodes. 3½ x 7½ IN.

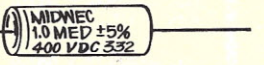
Brand New. **$2.99 ea.**

TTL SPECIALS

7496 — 5 Bit Universal Shift Register **4 FOR $1**
74L93 — New By T.I. Low Power 4 Bit Counter
3 FOR $1

Mylar Capacitor

1 MFD. 400 WVDC.
2 FOR $1



RCA TRIAC #2

#40536. Rated 3 AMP 400 PIV. TO-5 Case Mounted on Heatsink.

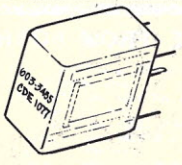
75¢ **3 FOR $2**

POWER RESISTORS

1 OHM 15W. 5%
3/$1.00

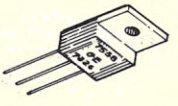
3.16 OHM 2W. 5%
5/$1.00

More Tantalum Caps
4.7 MFD 20V — 6/$1.00
22 MFD 20V — 4/$1.00



12VDC Relay by CDE.
SPDT. Coil is 280 ohm.
Small Size. **$1.29**

75¢

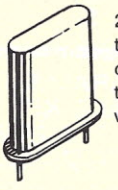


GE TRIAC

GE 10 AMP Triac

SC146D. House no. To-220 case.
Rated 10 amps 400PIV.
75¢ ea. **3/$2.00**

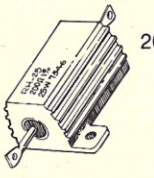
EXPERIMENTER'S CRYSTAL



262. 144KHZ. This frequency is 2 to the 18th power. Easily divided down to any power of 2, and even to 1HZ. New by CTS-Knight. A $5 value!

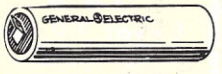
$1.25 each

DALE POWER RESISTOR



200 OHM 25 WATTS
1%. #RH-25
2 FOR $1

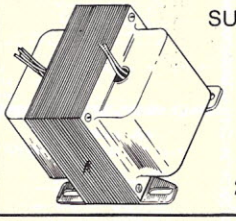
GE NICAD!



GE Ni-Cad Battery Pack
3 Cell pack, gives 4 volts at 900MAH. Brand new, factory fresh. Each cell is 2/3 "C" size. **$4.50/pack.**
Buy 3 packs (12 volts) for $10.95. Limited stock!

POWER SUPPLY TRANSFORMER

MFG. FOR ROCKWELL. Fully Encased Style.
PRI:115 VAC SEC:24 VAC at 2 AMPS.
And 15 VAC at 100 MA. Has a copper shield between PRI. and SEC.



SUPER QUALITY! **$3.99 each**

HEAVY DUTY!

PRODUCTION OVER-RUN

2½ x 3 x 2¼ IN.

RF CHOKE

225 UH. 2 AMPS.
By DEC.
FERRITE CORE **3 FOR $1**

CERAMIC CAPACITOR

1000 PF. 500 WVDC
Tubular, Dog Bone Style.
Low Temp. Coefficent,
Super Stable. **20 for $1**

NATIONAL SEMICONDUCTOR

SIX DIGIT ALARM CLOCK CHIP

National's second generation clock chip.
24 Pin Dip. Super easy to use.

FEATURES:
12 HOUR DISPLAY ★ 24 HOUR ALARM
4 OR 6 DIGITS ★ ALARM TONE OUTPUT
SNOOZE ALARM ★ EASY LED INTERFACE
POWER FAIL IND. ★ BRIGHTNESS CONTROL
AM/PM INDICATION ★ SINGLE POWER SUPPLY
FAST AND SLOW SET ★ LOW POWER

$1.95 each

COMPARE AT TWO OR THREE TIMES OUR PRICE!

WE SUPPLY FULL DATA, SPECS.

MM5375AA

HUGE SPECIAL PURCHASE!

SPECIAL OFFER!

With purchase of Clock Chip at left.
T.I. COMMON ANODE LED READOUTS
#TIL-312 .33 INCH.
HIGH EFFICIENCY!
A PERFECT MATE.

59¢ ea.

BUILD YOUR OWN CLOCK!
WE SUPPLY DATA!

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TO—220 Case. Rated 1 AMP. Major Brand! All full spec.

7805 — 5VDC POS. — 1.19
7812 — 12VDC POS. — 1.19
7824 — 24VDC POS. — 1.19
7905 — 5 VDC NEG. — 1.29

Buy any 3 — Deduct 10%!

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410D Static Rams 100 for $8.75 ea	6571AP Character Gen 5 for $10.00 ea.	4096 Dynamic Rams 100 for $3.50 ea.	DM8131N 100 for $2.25 ea.	TMS-4027 Dynamic Rams 100 for $3.50 ea	21L02 (450ns) Static Rams 100 for $1.10 ea.	1702A E-PROM 8 for $3.75 ea.	6502 Microprocessor 5 for $11.00 ea.	2708 (450ns) E PROM 8 for $11.00 ea.	21L02 (250ns) Static Rams 100 for $1.36 ea
Z-80A Microprocessor 5 for $25.00 ea.	8212 8 Bit I O Port 25 for $3.00 ea.	4116 (200ns) 16K Dynamic Ram for Apple Users 16 for $24.00 ea.	Z 80 Microprocessor 5 for $20.00 ea.	8224-4 Clock Gen. & Dvr 25 for $8.75 ea.	7438 Hex Buffer TS 100 for .70¢ ea.	74368 Hex Inverter TS 100 for .70¢ ea.	74LS367 Hex Buffer 100 for .70¢	74LS368 Hex Inverter 100 for .70¢	2513 (5v) Character Gen 5 for $9.00 ea.

MICROCOMPUTER COMPONENTS

MICROPROCESSOR'S

F8	8 Bit CPU (3850)	16.95 +
Z80	8 Bit CPU (Z80) (2MHz)	22.00 +
Z80A	8 Bit CPU (4MHz)	28.00 +
COP1802CD	8 Bit CPU	19.95 +
2650	8 Bit CPU	24.95 NEW
AM2901	4 Bit CPU	22.95
6502	8 Bit CPU	12.25 +
6800	8 Bit CPU	18.95 +
6802	MPU	25.00 NEW
8008-1	8 Bit CPU	9.95 +
8035	8 Bit CPU w clock 64 byte ram	22.00 NEW
8080A	8 Bit CPU	11.95 +
8085	8 Bit CPU (1.2us)	27.00 NEW
TMS9900TL	16 Bit CPU	67.00

8080A SUPPORT DEVICES

8212	8 Bit I O Port	3.50 +
8214	Priority Interrupt Control	9.00 +
8216	Bi-Directional Bus Driver	3.75 +
8224	Clock Generator & Driver (2MHz)	3.50 +
8224-4	Clock Generator & Driver (4MHz)	9.95 +
8226	Inverting Bi-Directional Bus Driver	3.95 NEW
8228	System Controller & Bus Driver	7.95 +
8238	System Controller & Bus Driver	7.50 +
8251	Programmable Communication Int	9.95 +
8253	Programmable Interval Timer	21.95 +
8255	Programmable Peripheral Int	21.95 +
8257	Prog. Direct Mem. Access Cont	21.95 +
8259	Programmable Interrupt Cont	21.95 +
8275	Programmable CRT Controller	75.00 NEW
8279	Programmable Keyed/Disp Int	20.00 NEW

FLOPPY DISC CONTROLLER

1771B	(WD)	55.95
1771B-01	(WD)	57.95 +

TV GAME CHIPS

TMS1955	6 Games TI	7.95 +

KEYBOARD CHIPS

AY5 2376	88 Keys 8 Bit + Parity (100KHz)	13.75 +
AY5 3600	90 Keys 10 Bit (100KHz)	13.75 +

FIFO

3341A	64 x 4 Bit 1.0 MHz	6.50
2812D	32 x 8 Bit 0.5 MHz	16.95 +

F-8 SUPPORT DEVICES

3851	Program Storage Unit	13.95 +
3853	Static Memory Interface	13.95 +

STATIC RAMS

		1-15	16-63	64 up
21L02	1K x 1 (450ns)	1.50	1.24	1.18 +
21L02	1K x 1 (300ns)	1.80	1.35	1.25 +
21L02	1K x 1 (250ns)	1.75	1.60	1.50 +
410D	4K x 1 (200ns)	10.75	10.00	9.25 +
1101A	256 x 1 (1 usec)	1.00	.90	.80 +
2101-1	256 x 4 (450ns)	2.95	2.75	2.60 –
2102	1K x 1 (1 usec)	1.25	1.15	1.00 –
2102-1	1K x 1 (450ns)	1.40	1.25	1.10 +
2111-1	256 x 4 (450ns)	3.95	3.50	3.25 +
2112-1	256 x 4 (450ns)	2.95	2.80	2.69 –
2114-3	1024 x 4 (300ns)	11.00	10.00	9.25 +
2125L	1024 bit (70ns)	11.10	9.00	8.30 NEW
2147	4096 x 1 (70ns)	37.50		NEW
3101	16 x 4 (110ns)	2.50	2.35	2.00 –
3106	256 x (Tri-State)	3.95	3.70	3.25 –
3107	256 x 1 (80ns)	3.95	3.70	3.25 –
TMS 4044(45)	4K x 1 (450ns)	9.95	9.00	8.95 NEW
4200A	4K x 1 (250ns)	12.95	11.95	11.00 +
TMS 4045(45)	1024 x 4 (450ns)	11.00	10.00	9.25 +
5101	256 x 4 (650ns)	8.30	7.40	7.25 +
74C89	16 x 4 (275ns)	3.25	3.05	2.85
7489	16 x 4 -Rev	2.25	2.10	1.90 +
74S201	256 x 1 (50ns)	4.50	4.00	3.75
P8101	256 x 4 (450ns)	4.20	3.40	2.80 NEW
P8155	256 x 8 22	17.00	14.00	NEW
P8156	256 x 8 22	21.00	18.00	NEW
8599	16 x 4 (50ns)	1.88	1.75	1.60
9102BPC	1K x 1 (250ns)	1.65	1.45	1.30

CHARACTER GENERATORS

2513	Upper + 12 +5	6.75
2513	Lower + 12 +5	6.75
2513	Upper (5 volt)	9.75 +
2513	Lower (5 volt)	10.95 +
2516	Upper + 12 +5	10.95 NEW
MCM6571	Upr. Lwr. & Greek Up Scan	10.95
MCM6571A	Upr. Lwr. & Greek Down Scan	10.95
MCM6574	Character Gen	13.75 +
MCM6575	Character Gen	13.25 +

WAVEFORM GENERATOR

8038	VCO	3.50 +
MC4024	Dual VCO	2.25 +
566	VCO Function	1.50 +

CLOCK CHIPS

MM5311	24 Pin BCD Output 6 Digits	6.95
MM5313	28 Pin 6 Digits	6.95
MM5314	24 Pin 6 Digits	6.95
MM5316	40 Pin Alarm Ledout (-F3817)	6.95
MM5375	Clock Chip	6.95
CT7001	Clock Chip Calendar	6.00

PROM'S

1702A	256 x 8 Bit (1 us) TS Erasable	4.00 +
2704	512 x 8 Bit (450ns) TS Erasable	15.00 +
2708	1024 x 8 Bit (450ns) TS Erasable	12.00 +
2716 (5+12Tt)	1024 x 16 Bit (450ns) Erasable	30.00 +
2716 (5+INTL)	1024 x 16 Bit (450ns) Erasable	38.00 NEW
2758 (5v)	1024 x 8 Bit (450ns) Erasable	28.00 NEW
D3601	1K Bit 256 X 4 OC (70ns)	4.50 –
D3604	4K Bit 512 x 8 OC (90ns)	13.00 NEW
5203AQ	256 x 8 Bit (1 us) TS Erasable	5.00 +
5304AQ	512 x 8 Bit (1 us) TS Erasable	8.00 +
6834	512 x 8 Bit (500ns) Erasable	17.50 +
6834-1	512 x 8 Bit (750ns) Erasable	14.95
825238	32 x 8 Bit (50ns) OC	4.00 –
8251298	256 x 4 Bit (50ns) TS	4.25 –
82238	32 x 8 Bit (50ns) OC	3.50 +

6800 SUPPORT

6810P	128 x 8 Static Ram (450ns)	4.95 –
6810P	128 x 8 Static Ram (250ns)	6.00 NEW
6820P	Peripheral Interface Adapter	7.50 +
6821P	Peripheral Interface Adapter	7.50 NEW
6828P	Priority Interrupt Controller	11.25 –
6834P	512 x 8 Bit Erasable Prom 500	16.95 –
6850P	Asynchronous Comm. Adapter	9.75 +
6852P	Synchnous Serial Data Adapter	11.75 +
6860P	0-600 RPS Modem	10.00 +
6862P	2400 RPS Modulator	14.50 +
6871P	Clock	28.00 NEW
6875P	Clock	8.75 NEW
6880P	MPU Bidir. Bus Ext	2.50 +

Z80 SUPPORT DEVICES

3881	Parallel I.O Controller	12.95 –
3882	Counter Timer Circuit	12.95 –

SHIFT REGISTERS STATIC

2518B	32 x 8 Bit 2.0 MHz	3.95 –
2533V1	1024 x 1 Bit 1.15 MHz	2.00 –
TMS3002	50 + 2 Bit 1.0 MHz	1.00 –
TMS3112	32 x 6 Bit 2.0 MHz	3.95 –
MM5058	1024 x 6 Bit 1.5 MHz	2.00 –

KIM

6102		8.00 NEW
6502	CPU	11.95 +
6520	Peripheral Interface Adapter	11.95 +
6522	Peripheral Interface Adapter	9.25 –
6530	RAM/ROM I/O Interval Timer	15.95 –
6530-002	RAM/ROM, I/O Interval Timer	15.95 –
6530-003	RAM/ROM, I/O Interval Timer	15.95 –
6530-004	TIM RAM/ROM I/O Interval Tim	15.95 –
6530-005	RAM ROM I O Interval Timer	15.95

DYNAMIC RAMS

4116D /4116	16K x 1 Bit (200ns) (16 pin)	32.00 +
1103	1024 x 1 Bit (300ns)	1.00 +
2104	4096 x 1 Bit (300ns) (16 pin)	4.00 +
21078	4096 x 1 Bit (300ns) (22 pin)	4.25 +
21078-4	4096 x 1 Bit (270ns) (22 pin)	3.95 +
TMS4050	4096 x 1 Bit (300ns) (18 pin)	4.00 +
TMS4060	4096 x 1 Bit (300ns) (22 pin)	4.50 +
TMS4070-2	16K x 1 Bit (200ns) (16 pin)	32.00 NEW
4096	4096 x 1 Bit (300ns) (16 pin)	4.00 +
4116 /4180	16K x 1 Bit (200ns) (16 pin)	32.00 +
MM5270	4096 x 1 Bit (200ns) 22 pin)	4.50 +
MCM6605	4096 x 1 Bit (200ns) (22 pin)	5.00 +

USRT

S2350	500K Baud (5 volt)	10.75 +

UART'S

AY5-1013A	30K Baud (12 +5)	5.25 +
AY5-1014A	40K Baud (5 volt)	8.25 +
TR1602B	20K Baud (12 +5)	5.25 +
TMS6011	200K Baud (12 +5)	5.95 +
IM6402	200K Baud (5 volt)	10.80
IM6403	200K Baud (5 volt)	10.80

MISC. OTHER COMPONENTS

N8T20	Bi-Directional One Shot	3.39 +
N8T26	MPU 31 Dir. Bds. Ext	2.10 +
N8T95	Hex Buffer Tri-State	1.35 –
N8T96	Hex Inverter Tri-State	1.35
N8T97	Hex Buffer Tri-State	1.35 –
N8T98	Hex Inverter Tri-State	1.35
81LS95	Lo Pwr TS Octal Buffer (True)	2.00
81LS97	Lo Pwr TS Octal Buffer (Inv.)	2.00
1488	RS232 Quad Line Driver	1.75 +
1489	RS232 Quad Receiver	1.75 +
D3205	1 of 8 Binary Decoder	4.00 NEW
D3207A	Quad NAND to MOS Driver	4.95 +
D3208A	Hex Sense Amplifier	14.20 NEW
D3211		10.00 NEW
83222	Refresh Controller	9.70 NEW
83242	Address Multiplexer & Refsh Cntr	10.15 NEW
D3245	Quad TTL MOS Driver	5.60 NEW
C3404	6 Bit Latch 12ns O/P Delay	6.75 +
P3408A	Hex MOS Sense Amp Tri-State	12.00 +
P4201A	Clock Generator	5.20 +
MM5320	TV Camera Sync Generator	7.50 –
MM5369	Oscillator Pre-Scaler	1.90 –
TMS9501	Multifunction I/O Controller	24.95
DM8130	10 Bit Comparator	2.90
DM8131	4 Input and NAND Tri-State	2.75 +
DM8833	Quad Tri-State Transceiver (True)	2.50
DM8835	Quad Tri-State Transceiver (Inv.)	2.50
DM8837	Hex Unified Bus Receiver	2.50 –
MK50240	Organ, Top Octave Generator	20.00 NEW
MK50250	Clock	15.00 NEW

STATIC RAM BOARDS

8K

250ns	ASSEMBLED & TESTED	$189.95
450ns	ASSEMBLED & TESTED	$149.75
250ns	KIT	$169.95
450ns	KIT	$125.00
BARE BOARD		25.00
6800	ADAPTER to S-100 System KIT	$12.95

16K

250ns	ASSEMBLED & TESTED	$435.00
450ns	ASSEMBLED & TESTED	$380.00
450ns	KIT	$335.00

32K

250ns	ASSEMBLED & TESTED	$850.00
450ns	ASSEMBLED & TESTED	$775.00
450ns	KIT	$675.00

DYNAMIC RAM BOARDS

On board Refresh power is provided with no wait states or cycle stealing required.
+8VDC 400MA DC, +18VDC 400MA DC and −18VDC 30MA DC.

	EXPANDABLE	32K	
8K	(375ns)	KIT	$151.00
16K	(375ns)	KIT	$259.00
24K	(375ns)	KIT	$367.00
32K	(375ns)	KIT	$425.00

	EXPANDABLE	64K	
16K	(375ns)	KIT	$281.00
32K	(375ns)	KIT	$519.00
48K	(375ns)	KIT	$757.00
64K	(375ns)	KIT	$995.00

JADE PARALLEL/SERIAL INTERFACE KIT

$124.95 KIT

S-100
2 Serial Interfaces with RS232 interfaces or 1 Kansas City cassette interface.
Serial interfaces are crystal controlled.
Selectable baud rates.
Cassette works up to 1200 baud.
1 parallel port.

JADE VIDEO INTERFACE KIT

FEATURES $99.95

S-100 Bus Compatible
32 or 64 Characters per line
16 lines
Graphics (128 x 48 matrix)
Parallel & Compositive video
On board low-power memory

Powerful software included for cursor, home, EOL, Scroll Graphics/ Character, etc.
Upper case, lower case & Greek
Black-on-white & white-on-black

COMPU/TIME CT 100

$100 BUS COMPATIBLE

TIME & CALENDAR

Microprocessors need the power that a real-time clock can offer. Date and time becomes instantly available **COMPU/TIME** does not have to be initialized every time the system is powered up. It possesses a crystal-controlled time base to obtain superior accuracy and has two setable coincidence counters. Time, date, and counters are set via software.

COMPUTATIONAL FUNCTION

Microprocessors need to be complimented by hardware arithmetics to free up memory pages dedicated to floating point routines and mathmatical software. **COMPU/TIME** provides a 40 function calculator array so that algebraic, trigonometric, basic arithmetic problems can be solved without the need of developing sophisticated software.

Buy It Your Way

COMPU/TIME	CT100	$199	KIT	$245	Assembled
COMPU only	C101	$149	KIT	$189	Assembled
TIME only	T101	$165	KIT	$205	Assembled
COMPU TIME	PC Board only		$80		

NUMBER CRUNCHER

The CT200 is a number oriented microprocessor intended for use in those applications that require fast versatile mathematical solutions.
THIS IS NOT A CALCULATOR CHIP. THERE ARE NO KEY DELAYS.
The CT200 has a unique architecture that is designed to be a TASK processing system within a system. This unique architecture will allow the CT200 to work and run with ANY S100 BUS microprocessor system. It is completely compatible with Z80, 4MHZ version also 8080, 6800, 6502 microprocessor. A micro incoded instruction set allows programming in a calculator like language. The instruction set includes a full set of test and branch instructions. All decoding of S100 bus signals (to select or control functions) is performed with strobed latches to eliminate the possibility of glitches.

PRICE: **$249.00**
Includes Manual, ASSEMBLED & TESTED.

full ASCII PROFESSIONAL KEYBOARDS

Full 128 Character ASCII!!
Tri-Mode MOS Encoding!
MOS, DTL, TTL Compatible Output!
Two-key Rollover!
Level and Pulse Strobe!
Shift and Alpha Lock!
Selectable Parity!
Positive or Negative Logic!
(56 keys)

MODEL 756

PRICING INFORMATION

Model 756 (assembled)	$75.95
Model 756K (kit)	64.95
Model 702 Enclosure	29.95
Model 710 Numeric Pad	9.95
Model 756MF Mtg. Frame	8.95

TARBELL CASSETTE INTERFACE

- Plugs directly into your IMSAI or ALTAIR*
- Fastest transfer rate. 187 (standard) to 540 bytes/ second
- Extremely Reliable – Phase encoded (self clocking)
- 4 Extra Status Lines, 4 Extra Control Lines
- 37 page manual included
- Device Code Selectable by DIP switch
- Capable of Generating Kansas City tapes also
- No modification required on audio cassette recorder

JADE KIT* $99.95 ASSEMBLED $175.00
*16 month warranty from JADE! MANUAL $4.00

DATA COMMUNICATIONS ADAPTER

80-103A Serial I/O and FSK modem for professional and hobby communications.

- **Completely compatible with your IMSAI, ALTAIR* SOL** or other S-100 microcomputers.
  *Trademarks of **MITS, ***Processor Technology
- **Designed for use on the dial telephone or TWX networks, or 2-wire dedicated lines, meets all FCC regulations when used with a CBT coupler.**
- **All digital modulation and demodulation with on board crystal clock and precision filter mean that NO ADJUSTMENTS ARE REQUIRED**
  - **Bell 103 standard frequencies**
  - **Automated dial (pulsed) and answer**
  - **Originate and answer mode**
  - **110 or 300 BPS speed select**
  - **Complete self test capability**
  - **Character length, stop bit, and parity**
  - **90 day warranty and full documentation**

PRICES: BARE BOARD and Manual $49.95
Assembled (48 hr. burn in) $279.95
JG-DCA KIT $159.95

JADE REAL TIME CLOCK FOR S-100 BUS

1 MHZ Crystal Oscillator
Two independent interrupts
One interrupt uses 16 bit counter in 10 USEC steps
Other interrupt is in decade steps from 100 USEC to 10 sec.
Both software programmable
Board can be selected by 128 device code pairs.
Complete documentation includes software to display time of day.
Double sided solder mask
Silk screen parts layout

JG-RT ASSEMBLED & TESTED $179.95
JG-RT KIT $124.95
BARE BOARD with Manual $30.00

JADE 8080A KIT

$100.00 KIT
BARE BOARD $30.00

JADE Z80 KIT

—with PROVISIONS for ONBOARD 2708 and POWER ON JUMP

$135.00 EA. (2MHZ)
$149.95 EA. (4MHZ)
BARE BOARD **$35.00**

JADE Z80 "UPGRADE" KIT

Change your JADE 2MHz Z80 to a 4MHz version with this simple kit.

only **$17.95 with trade**
$49.95 purchase.

To trade, you must give us your 2MHz Z80 chip and 8224 clock driver.

The "UPGRADE KIT" includes.

Z80A chip,	1.8K resistor
8224-4 clock driver	20 pf. capacitor
36MHz crystal	

E–PROM BOARDS

MR-8 (8K uses 2708) with 1K RAM	KIT	$99.50
MR-16T (16K uses 2716) with 1K RAM	KIT	$99.50
MM-16 (16K uses 2708)		$99.00
RAM/N/ROM (16K uses any E-PROM)	KIT	$117.00
JG-8/16 (uses 2708 or 2716)	KIT	$59.95
BARE BOARD		$30.00

TV-1

Convert T.V. set to Video Monitor.
KIT $8.95

THE PROM SETTER

WRITE & READ
EPROM
1702A – 2708 – 2716
5204 – 6834

- Plugs directly into your ALTAIR IMSAI Computer
- Includes Main Module Board and External EPROM Socket Unit.
- The EPROM Socket Unit is connected to the Computer through a 25 pin connector.
- Programming is accomplished by the Computer.
- Just read in the Program to be Written on the EPROM into your Processor and let the Computer do the rest.
- Use Socket Unit to Read EPROM's Contents into your Computer.
- Software included
- No external power supplies. Your computer does it all.
- Doubles as an Eight Bit Parallel I/O.
- Manual included.

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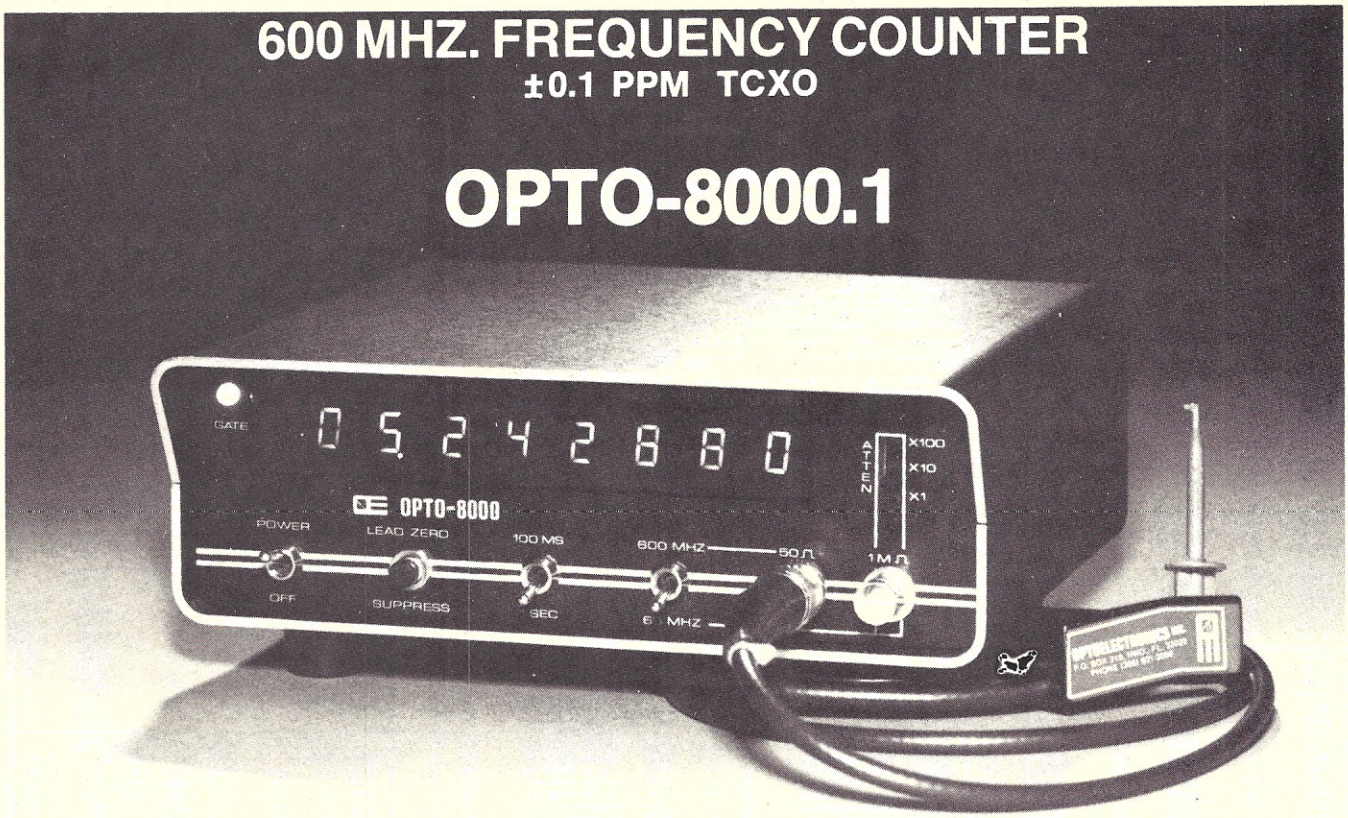
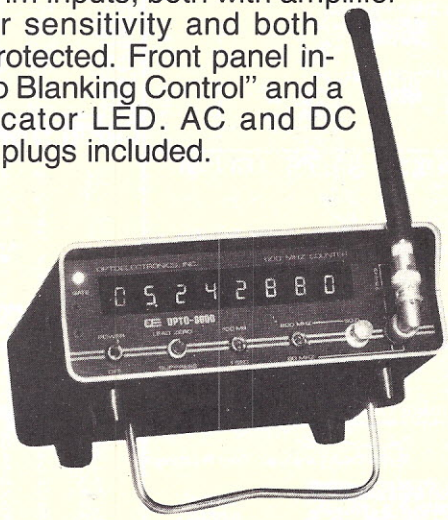
NEW CATALOG NOW AVAILABLE J6

600 MHZ. FREQUENCY COUNTER
±0.1 PPM TCXO

OPTO-8000.1



This new instrument has taken a giant step in front of the multitude of counters now available. The Opto-8000.1 boasts a combination of features and specifications not found in units costing several times its price. Accuracy of ±0.1 PPM or better — *Guaranteed* — with a factory-adjusted, sealed TCXO (Temperature Compensated Xtal Oscillator). **Even kits require no adjustment for guaranteed accuracy!** Built-in, selectable-step attenuator, rugged and attractive, black anodized aluminum case (.090″ thick aluminum) with tilt bail. 50 Ohm and 1 Megohm inputs, both with amplifier circuits for super sensitivity and both diode/overload protected. Front panel includes "Lead Zero Blanking Control" and a gate period indicator LED. AC and DC power cords with plugs included.



SPECIFICATIONS:
Time Base—TCXO ±0.1 PPM GUARANTEED!
Frequency Range—10 Hz to 600 MHz
Resolution—1 Hz to 60 MHz; 10 Hz to 600 MHz
Decimal Point—Automatic
All IC's socketed (kits and factory-wired)
Display—8 digit LED
Gate Times—1 second and 1/10 second
Selectable Input Attenuation—X1, X10, X100
Input Connectors Type —BNC
Approximate Size—3″h x 7½″w x 6½″d
Approximate Weight—2½ pounds
Cabinet—black anodized aluminum (.090″ thickness)
Input Power—9-15 VDC, 115 VAC 50/60 Hz
or internal batteries

OPTO-8000.1 Factory Wired **$299.95**
OPTO-8000.1K Kit **$249.95**

ACCESSORIES:
Battery-Pack Option—Internal Ni-Cad Batteries and charging unit **$19.95**
Probes: P-100—DC Probe, may also be used with scope **$13.95**
P-101—LO-Pass Probe, very useful at audio frequencies **$16.95**
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VHF RF Pick-Up Antenna-Rubber Duck w/BNC #Duck-4H **$12.50**
Right Angle BNC adapter #RA-BNC **$ 2.95**

FC-50 — Opto-8000 Conversion Kits:
Owners of FC-50 counters with #PSL-650 Prescaler can use this kit to convert their units to the Opto-8000 style case, including most of the features.
FC-50 — Opto-8000 **Kit $59.95**
*FC-50 — Opto-8000F **Factory Update $99.95**
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*FC-50 — Opto-8000.1F **Factory Update $149.95**
*Units returned for factory update must be completely assembled and operational

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SN7404N	.18	SN7475N	.49	SN74163N	.89
SN7405N	.20	SN7476N	.35	SN74164N	.89
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SN7409N	.20	SN7483N	.59	SN74170N	1.59
SN7410N	.18	SN7485N	.79	SN74172N	6.00
SN7411N	.25	SN7486N	.35	SN74173N	1.25
SN7412N	.25	SN7489N	1.75	SN74174N	.89
SN7413N	.40	SN7490N	.45	SN74175N	.79
SN7414N	.70	SN7491N	.59	SN74176N	.79
SN7416N	.25	SN7492N	.43	SN74177N	.79
SN7417N	.25	SN7493N	.43	SN74179N	1.95
SN7420N	.20	SN7494N	.65	SN74180N	.79
SN7421N	.29	SN7495N	.65	SN74181N	1.95
SN7422N	.39	SN7496N	.65	SN74182N	.79
SN7423N	.25	SN7497N	3.00	SN74184N	1.95
SN7425N	.29	SN74100N	.89	SN74185N	1.95
SN7426N	.29	SN74107N	.35	**SN74186N**	9.95
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SN7429N	.39	SN74116N	1.95	SN74190N	1.25
SN7430N	.20	SN74121N	.35	SN74191N	1.25
SN7432N	.25	SN74122N	.39	SN74192N	.79
SN7437N	.25	SN74123N	.49	SN74193N	.79
SN7438N	.25	SN74125N	.49	SN74194N	.89
SN7439N	.25	SN74126N	.49	SN74195N	.69
SN7440N	.20	SN74132N	.75	SN74196N	.89
SN7441N	.89	SN74136N	.75	SN74197N	.89
SN7442N	.49	SN74141N	.79	SN74198N	1.49
SN7443N	.75	SN74142N	2.95	SN74199N	1.49
SN7444N	.75	SN74143N	2.95	SN74200N	5.59
SN7445N	.75	SN74144N	2.95	SN74251N	1.79
SN7446N	.69	SN74145N	.79	SN74279N	.79
SN7447N	.59	SN74147N	1.95	SN74283N	2.25
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SN7451N	.20	SN74151N	.59	SN74365N	.69
SN7453N	.20	SN74153N	.59	SN74366N	.69
SN7454N	.20	SN74154N	.99	SN74367N	.69
SN7459A	.25	SN74155N	.79	SN74368N	.69
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CD4000	.23			CD4070	.55
CD4001	.23			CD4071	.23
CD4002	.23	CD4028	.89	CD4072	.49
CD4006	1.19	CD4029	1.19	CD4076	1.39
CD4007	.25	CD4030	.49	CD4081	.23
CD4009	.49	CD4035	.99	CD4082	.23
CD4010	.49	CD4040	1.19	CD4093	.99
CD4011	.23	CD4041	1.25	CD4098	2.49
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CD4013	.39	CD4043	.89	MC14410	14.95
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CD4025	.23	CD4066	.79	CD4518	1.29
CD4026	2.25	CD4068	.39	CD4520	1.29
CD4027	.69	CD4069	.45	CD4566	2.25

74C00

74C00	.39			74C163	3.00
74C02	.55			74C164	3.25
74C04	.75	74C89	6.49	74C173	2.60
74C08	.75	74C90	3.00	74C192	3.49
74C10	.65	74C93	2.00	74C193	2.75
74C14	3.00	74C95	2.00	74C195	2.75
74C20	.65	74C107	1.25	74C922	9.95
74C30	.65	74C151	2.90	74C923	8.95
74C42	2.15	74C154	3.00	74C925	14.95
74C48	4.75	74C157	2.15	74C926	11.95
74C73	1.50	74C160	3.25	80C95	1.50
74C74	1.15	74C161	3.25	80C97	1.50

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LM301H	.35			LM741CH	.35
LM301CN	.35			LM741CN	.35
LM302H	.75	LM340T-8	1.25	LM741-14N	.39
LM304H	1.00	LM340T-12	1.25	LM747H	.79
LM305H	.60	LM340T-15	1.25	LM747N	.79
LM307CN/H	.35	LM340T-18	1.25	LM748H	.39
LM308H	1.00	LM340T-24	1.25	LM748N	.39
LM308CN	1.00	LM350N	1.00	LM1303N	.90
LM309H	1.10	LM351CN	.65	LM1304N	1.19
LM309K	1.25	LM370N	1.15	LM1305N	1.40
LM310CN	1.15	LM373N	3.25	LM1307N	.85
LM311H	.90	LM377N	4.00	LM1310N	2.95
LM311N	.90	LM380N	1.25	LM1351N	1.65
LM317K	6.50	LM380CN	.99	LM1414N	1.75
LM318CN	1.50	LM381N	1.79	LM1458CN/H	.59
LM319N	1.30	LM382N	1.79	MC1488	1.95
LM320K-5	1.35	NE501N	8.00	MC1489	1.95
LM320K-5.2	1.35	NE510A	6.00	LM1496N	.95
LM320K-12	1.35	NE529A	4.95	LM1556V	1.75
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LM320K-24	1.35	NE540L	6.00	LM3053	1.50
LM320T-5	1.25	NE550N	1.30	LM3065N	.69
LM320T-5.2	1.25	NE555V	.39	LM3900N(3401)	.49
LM320T-8	1.25	NE556	.99	LM3905N	.89
LM320T-12	1.25	NE560B	5.00	LM3909	1.25
LM320T-15	1.25	NE561B	5.00	MC5558V	1.00
LM320T-18	1.25	NE562B	5.00	LM7525N	.90
LM320T-24	1.25	NE565N	1.75	**LM7534N**	.75
LM323K-5	5.95	NE565N	1.25	80388	4.95
LM324N	1.80	NE566CN	1.75	LM7545Q	.49
LM339N	.99	NE567H	1.25	75451CN	.39
LM340K-5	1.35	NE567V	.99	75452CN	.39
LM340K-6	1.35	NE570	10.50	75453CN	.39
LM340K-8	1.35	LM703CN/H	.45	75454CN	.39
LM340K-12	1.35	LM709H	.29	75491CN	.79
LM340K-15	1.35	LM709N	.29	75492CN	.89
LM340K-18	1.35	LM710N	.79	75494CN	.89
LM340K-24	1.35	LM711N	.39	RC4151	5.95
LM340T-5	1.25	LM723H	.55	RC4194	5.95
LM340T-6	1.25	LM723N	.55	RC4195	4.49

74LS00 TTL

74LS00	.23			74LS155	.69
74LS02	.23			74LS157	.69
74LS03	.23	74LS74	.35	74LS160	.89
74LS04	.29	74LS75	.49	74LS161	.89
74LS05	.29	74LS76	.35	74LS162	.89
74LS08	.23	74LS83	.75	74LS163	.89
74LS10	.23	74LS85	.99	74LS164	.99
74LS13	.49	74LS86	.35	74LS175	.79
74LS14	.99	74LS90	.49	74LS181	2.49
74LS20	.23	74LS92	.59	74LS190	.89
74LS26	.29	74LS93	.59	74LS191	.89
74LS27	.29	74LS95	.79	74LS192	.89
74LS28	.29	74LS96	.89	74LS193	.89
74LS30	.23	74LS107	.35	74LS194	.89
74LS32	.29	74LS109	.35	74LS195	.89
74LS40	.29	74LS112	.35	74LS253	.79
74LS42	.69	74LS123	.99	74LS257	.69
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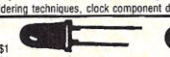

	.125" dia.			.185" dia.			.200" dia.			.190" dia.	
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XC209	Green	4/$1	XC526	Red	100/$8	XC556	Green	4/$1	XC111	Green	4/$1
XC209	Orange	4/$1	XC526	Green	4/$1	XC556	Yellow	4/$1	XC111	Yellow	4/$1
XC209	Yellow	4/$1	XC526	Yellow	4/$1	XC556	Orange	4/$1	XC111	Orange	4/$1
	.200" dia									.085" dia.	
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MAN 3	Common Cathode-red	.125	.25	MAN 6730	Common Anode-red ±1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6740	Common Cathode-red-D.D.	.560	.99
MAN 52	Common Anode-green	.300	1.25	MAN 6750	Common Cathode-red ±1	.560	.99
MAN 71	Common Anode-red	.300	1.25	MAN 6760	Common Anode-red	.560	.99
MAN 72	Common Anode-red	.300	.99	MAN 6780	Common Cathode-red	.560	.99
MAN 74	Common Cathode-red	.300	1.25	DL701	Common Anode-red ±1	.300	.99
MAN 81	Common Anode-yellow	.300	.99	DL702	Common Cathode-red	.300	1.25
MAN 82	Common Anode-yellow	.300	.99	DL704	Common Cathode-red	.300	.99
MAN 84	Common Cathode-yellow	.300	.99	DL707	Common Anode-red	.300	.99
MAN 3620	Common Anode-orange	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3630	Common Anode-orange ±1	.300	.99	DL746	Common Anode-red ±1	.630	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 4610	Common Anode-orange	.300	.99	DL749	Common Cathode-red ±1	.630	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL750	Common Cathode-red	.600	1.49
MAN 4710	Common Anode-red ±1	.400	.99	DL33B	Common Cathode-red	.110	.35
MAN 4730	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Anode	.350	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode (FND500)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6630	Common Anode-orange	.560	.99	5082-7300	4 x 7 Sgl. Digit-RHDP	.600	19.95
MAN 6640	Common Cathode-orange-D.D.	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6650	Common Cathode-orange ±1	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6660	Common Anode-orange	.560	.99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

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CA3013	2.15	CA3082	2.00
CA2023	2.56	CA3083	1.60
CA3035	2.48	CA3086	.85
CA3039	1.35	CA3089	3.75
CA3046	1.30	CA3130	1.39
CA3059	3.25	CA3140	1.25
CA3060	3.25	CA3160	1.25
CA3080	.85	CA3401	.49
CA3081	2.00	CA3600	3.50

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MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
5030	7.95

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MM5311	4.95
MM5312	4.95
MM5314	4.95
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22 pin LP	$ .37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

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24 pin ST	.49	.45	.42
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40 pin ST	1.59	1.45	1.30

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14 pin SG	.35	.32	.29
16 pin SG	.38	.35	.32
18 pin SG	.52	.47	.43
24 pin SG	$ .70	.63	.57
28 pin SG	1.10	1.00	.90
36 pin SG	1.75	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

8 pin WW	$ .40	.38	.35
10 pin WW	.45	.41	.37
14 pin WW	.39	.38	.37
16 pin WW	.43	.42	.41
18 pin WW	.75	.68	.62
22 pin WW	.95	.85	.75
24 pin WW	1.05	.95	.85
28 pin WW	1.40	1.25	1.10
36 pin WW	1.59	1.45	1.30
40 pin WW	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea.	10 OHM	12 OHM	15 OHM	18 OHM	22 OHM	1/4 WATT 5% = 50 PCS.
		27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	
		68 OHM	82 OHM	100 OHM	120 OHM	150 OHM	
ASST. 2	5 ea.	180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	1/4 WATT 5% = 50 PCS.
		470 OHM	560 OHM	680 OHM	820 OHM	1K	
ASST. 3	5 ea.	1.2K	1.5K	1.8K	2.2K	2.7K	1/4 WATT 5% = 50 PCS.
		3.3K	3.9K	4.7K	5.6K	6.8K	
ASST. 4	5 ea.	8.2K	10K	12K	15K	18K	1/4 WATT 5% = 50 PCS.
		22K	27K	33K	39K	47K	
ASST. 5	5 ea.	56K	68K	82K	100K	120K	1/4 WATT 5% = 50 PCS.
		150K	180K	220K	270K	330K	
ASST. 6	5 ea.	390K	470K	560K	680K	820K	1/4 WATT 5% = 50 PCS.
		1M	1.2M	1.5M	1.8M	2.2M	
ASST. 7	5 ea.	2.7M	3.3M	3.9M	4.7M	5.6M	1/4 WATT 5% = 50 PCS.
ASST. 8R	Includes Resistor Assortments 1-7 (350 PCS.)						$9.95 ea.

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets — 25¢
1978 A Catalog Available—Send 35¢ stamp

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a division of JAMES ELECTRONICS of California

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1021 HOWARD AVENUE, SAN CARLOS, CA 94070
Advertised Prices Good Thru June

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire.

$12.95

WIRE WRAP TOOL WSU-30
WRAP • STRIP • UNWRAP -$6.95

WIRE WRAP WIRE — 30 AWG

25 ft. min. $1.25 50 ft. $1.95 100 ft. $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30

- 50 ft. roll 30 AWG KYNAR wire wrap wire **$3.95 ea.**
- Cuts wire to desired length
- Strips 1" of insulation **Specify** — Blue-Yellow-White-Red

REPLACEMENT DISPENSER SPOOLS FOR WD 30
Specify blue, yellow, white or red **$1.98/spool**

EXAR

XR-L555 $1.50
Micro-Power version of the popular 555 Timer and directly interchangeable. Dissipates 1/15th the power and operates down to 2.7 volts. Perfect for battery operation and CMOS circuits.

XR2242CP $1.50
Precision timing circuit for generating timing pulses in **minutes, hours** and days or up to 1 year by using two. Reduces cost of time delay circuits: Basic 555 Timer with built-in 8-bit Counter.

XR2206KA-$14.95		XR2206KB-$19.95			
XR205	$ 8.40	XR1489	1.39	XR2556	$ 3.20
XR210	4.40	XR1800	3.20	XR2567	2.99
XR215	4.40	XR2206	4.40	XR3403	1.25
XR320	1.55	XR2207	3.85	XR4136	1.25
XR555	.39	XR2208	5.20	XR4151	2.85
XR556	.99	XR2209	1.75	XR4194	1.45
XR567CP	.99	XR2211	5.25	XR4202	3.60
XR567CT	1.25	XR2212	4.35	XR4212	2.05
XR1310P	1.30	XR2240	3.45	XR4558	.75
XR1468CN	3.85	XR2264	4.25	XR4739	1.15
XR1488	1.39			XR4741	1.4

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N745	3.3	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	4/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4305	75	25m	20/1.00
1N5232	5.6	500m	28	1N4734	5.6	1w	28
1N5234	6.2	500m	28	1N4735	6.2	1w	28
1N5235	6.8	500m	28	1N4736	6.8	1w	28
1N5236	7.5	500m	28	1N4738	8.2	1w	28
1N456	25	40m	6/1.00	1N4742	12	1w	28
1N458	150	7m	6/1.00	1N4744	15	1w	28
1N485A	180	10m	5/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.70
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C38M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
TIS133	5/1.00	PN3567	3/1.00	PN4249	4/1.00
TIS135	5/1.00	PN3568	4/1.00	PN4250	4/1.00
40409	1.75	PN3569	4/1.00	2N4400	4/1.00
40410	1.75	MPS3638A	5/1.00	2N4401	4/1.00
40673	1.75	MPS3702	5/1.00	2N4402	4/1.00
2N918	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2219A	3/1.00	MPS3704	5/1.00	2N4409	5/1.00
2N2221A	4/1.00	2N3705	5/1.00	PN5086	4/1.00
2N2222A	5/1.00	MPS3705	5/1.00	PN5087	4/1.00
2N2369	5/1.00	2N3706	5/1.00	PN5088	4/1.00
2N2369A	4/1.00	MPS3706	5/1.00	PN5089	4/1.00
MPS2369	5/1.00	2N3707	5/1.00	PN5129	5/1.00
2N2484	4/1.00	2N3711	5/1.00	PN5134	5/1.00
2N2906	4/1.00	2N3724A	.65	PN5138	5/1.00
2N2907	5/1.00	2N3725A	1.00	PN5139	5/1.00
2N2925	5/1.00	2N3772	2.25	PN5210	5/1.00
MJE2955	1.25	2N3823	1.00	2N5449	5/1.00
2N3053	2/1.00	2N3903	4/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.05	.04	.03	.001μF	.05	.04	.035
22 pf	.05	.04	.03	.0047μF	.05	.04	.035
47 pf	.05	.04	.03	.01μF	.05	.04	.035
100 pf	.05	.04	.03	.022μF	.06	.05	.04
220 pf	.05	.04	.03	.047μF	.06	.05	.04
470 pf	.05	.04	.035	.1μF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19

SOCKET JUMPERS

Mates with two rows of .025" sq. or dia. posts on patterns of .100" centers and shielded receptacles. Probe access holes in back. Choice of 6" or 18" length.

Part No.	No. of Contacts	Length	Price
924003-18R	26	18"	$ 5.38 ea.
924003-06R	26	6"	4.78 ea.
924005-18R	40	18"	8.27 ea.
924005-06R	40	6"	7.33 ea.
924006-18R	50	18"	10.31 ea.
924006-06R	50	6"	9.15 ea.

JUMPER HEADERS

Solder to PC boards for instant plug-in access via socket-connector jumpers. .025" sq. posts. Choice of straight or right angle.

Part No.	No. of Posts	Angle	Price
923863-R	26	straight	$1.28 ea.
923873-R	26	right angle	1.52 ea.
923865-R	40	straight	1.94 ea.
923875-R	40	right angle	2.30 ea.
923866-R	50	straight	2.36 ea.
923876-R	50	right angle	2.82 ea.

INTRA-CONNECTOR

Provides both straight and right angle functions. Mates with standard .10" x .10" dual row connectors (i.e. 3m, Ainsley, etc.) Permits quick testing of inaccessible lines.

Part No.: 922576-26 **No. of contacts:** 26 **Price** $6.90 ea.

INTRA-SWITCH

Permits instant line-by-line switching for diagnostic or QA testing. Switches actuated with pencil or probe tip. Mates with standard .10" x .10" dual-row connectors. Low profile design. Switch buttons recessed to eliminate accidental switching.

Part No.: IS-26 **No. of contacts:** 26 **Price** $13.80 ea.

CRYSTALS

THESE FREQUENCIES ONLY

PART NO.	FREQUENCY	CASE	PRICE
CY1A	1.000MHz	HC33	5.95
CY1.84	1.8432MHz	HC33	5.95
CY2A	2.000MHz	HC33	5.95
CY2.01	2.010MHz	HC33	1.95
CY2.50	2.500MHz	HC33	4.95
CY3.27	3.2768MHz	HC33	4.95
CY3.57	3.579545MHz	HC33	4.95
CY3A	4.000MHz	HC18	4.95
CY4.91	4.916MHz	HC18	4.95
CY7A	5.000MHz	HC18	4.95
CY5.18	5.185MHz	HC18	4.95
CY6.14	6.144MHz	HC18	4.95
CY6.40	6.400MHz	HC18	4.95
CY6.55	6.5536MHz	HC18	4.95
CY12A	10.000MHz	HC18	4.95
CY14A	14.31818MHz	HC18	4.95
CY19A	18.000MHz	HC18	4.95
CY18.43	18.432MHz	HC18	4.95
CY22A	20.000MHz	HC18	4.95
CY30A	32.000MHz	HC18	4.95

SWITCHES

¼" mounting holes

					1-9	10+
TOGGLE (sub-minature)	JMT121	SPDT	on-off-on		$1.95	$1.43
	JMT123	SPDT	on-none-on		1.65	1.21
	JMT221	DPDT	on-off-on		2.55	1.87
	JMT223	DPDT	on-none-on		2.15	1.58
TOGGLE (Printed Circuit)	MPC121	SPDT	on-off-on		$2.05	$1.53
	MPC123	SPDT	on-none-on		1.75	1.31
	MPC221	DPDT	on-off-on		2.65	1.97
	MPC223	DPDT	on-none-on		2.25	1.68
PUSH BUTTON	PB123	SPDT	maintained		1.95	1.47
	PB126	SPDT	momentary		1.95	1.47
PUSH BUTTON Minature	MS102	DPST	momentary	open	.35	.30
	MS103	SPST	momentary	closed	.35	.30
DIPSWITCH SPST	206-4	8 pin dip	4 switch		1.75	1.65
	206-7	14 pin dip	7 switch		1.95	1.85
	206-8	16 pin dip	8 switch		2.25	2.15

1/16 VECTOR BOARD

	0.1" Hole Spacing Part No.	P-Pattern L	W	Price 1-9	10 up
PHENOLIC	64P44 062XXXP	4.50	6.50	1.72	1.54
	169P44 062XXXP	4.50	17.00	3.69	3.32
EPOXY GLASS	64P44 062WE	4.50	6.50	2.07	1.86
	84P44 062WE	4.50	8.50	2.56	2.31
	169P44 062WE	4.50	17.00	5.04	4.53
	169P84 062WE	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	169P44 062WEC1	4.50	17.00	6.80	6.12

SLIT-N-WRAP

Model P180 includes 2-100' spools #28 AWG wire wrap wire

Supplies insulated wire from spool to wrap-posts without prestripping and precutting using "daisy chain" method.

Model P180 **$24.50**

REPLACEMENT WRAP BIT for P180 Slit N Wrap
No. P180A $12.95 each

Replacement wire-wrap wire for P180 #28 AWG (pkg. of 3) $2.75 each
W28-2-A green W28-2-B red
W28-2-C clear W28-2-D blue

INSTRUMENT/ CLOCK CASE

Injection molded unit. Complete with red bezel. 4½" x 4" x 1-9/16".

$3.49

MICROPROCESSOR COMPONENTS

CDP 1802	CPU	$19.95	Z80	CPU	$24.95
P8085	CPU	29.95	2650	MPU	26.50
8080A	CPU	10.95	MC6800	MPU	19.95
8212	8-Bit Input/Output	4.95	MC6810API	128 X 8 Static Ram	5.95
8214	Priority Interrupt Control	7.95	MC6820	Periph. Interface Adapter	7.95
8216	Bi-Directional Bus Driver	4.95	MC6821	Periph. Interface Adapter	11.50
8224	Clock Generator/Driver	5.95	MC6830L8	1024 X 8 Bit ROM	14.95
8228	System Controller/Bus Driver	5.95	MC6850	Asychronous Comm. Adapter	14.95

USER MANUALS

1802M	CDP1802 Manual	$ 7.50
Z80M	Z80 Manual	7.50
2650M	2650 Manual	5.00

SHIFT REGISTERS

MM500H	Dual 25 Bit Dynamic	.50
MM503H	Dual 50 Bit Dynamic	.50
MM504H	Dual 16 Bit Static	.50
MM506H	Dual 100 Bit Static	.50
MM507H	Dual 100 Bit Static	.50
MM510H	Dual 64 Bit Accumulator	.50
MM5013N	1024 Bit Accumulator Dynamic	2.95
MM5016H	500/512 Bit Dynamic	.89
MM5017N	Dual 500/512 Bit Dynamic	2.95
2504T	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4.95
2519	Hex 40 Bit Static	4.00
2522	Dual 132 Bit Static	2.95
2524	512 Dynamic	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual 250 Static	4.00
2529	Dual 240 Bit Static	4.00
2532	Quad 80 Bit Static	2.95
2533	1024 Static	2.95
3341	Fifo	6.95
74LS670	4 X 4 Register	1.95

ROM'S

2513(2140)	Character Generator (upper case)	$ 9.95
2513(3021)	Character Generator (lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048 Bit Read Only Memory	1.95

UART'S

AY-5-1013	30K BAUD	$ 5.95

RAM'S

1101	256 X 1	Static	$ 1.49
1103	1024 X 1	Dynamic	.99
2101	256 X 4	Static	5.95
2102	1024 X 1	Static	1.75
2107/5280	4096 X 1	Dynamic	4.95
2111	256 X 4	Static	6.95
2114	4K X 1	Static 450ns	9.95
2114L	4K X 1	Static 450ns Low Power	10.95
2114-3	4K X 1	Static 300ns	10.95
2114L-3	4K X 1	Static 300ns Low Power	11.95
7489	16 X 4	Static	4.95
8101	256 X 4	Static	5.95
8111	256 X 4	Static	6.95
8599	16 X 4	Static	3.49
21L02	1024 X 1	Static	1.95
74200	256 X 1	Static	6.95
93421	256 X 1	Static	2.95
MM5262	2K X 1	Dynamic	49
MK4027 (UPD414)	4K	DYNAMIC 16 PIN	5.95
MK4116 (UPD416)	16K	DYNAMIC 16 PIN	29.95
TMS4044-45NL	4K	STATIC	14.95

PROMS

1702A	2048	Famous	$ 5.95
5203	2048	Famous	14.95
82S23	32 X 8	Open C	5.00
82S115	4096	Bipolar	19.95
82S123	32 X 8	Tristate	5.00
74S287	1024	Static	7.95
2708	8K	EPROM	10.95
2716 T.I.	16K	EPROM	29.95
2716 Intel	16K	EPROM	59.95
6301-1	1024	Tri-State Bipolar	3.49
6330-1	256	Open C Bipolar	2.95
74186	512	TTL Open Collector	9.95
74188	256	TTL Open Collector	3.95

SPECIAL REQUESTED ITEMS

TELEPHONE KEYBOARD CHIPS

AY-5-9100	$14.95
AY-5-9200	14.95
AY-5-9500	4.95
AY-5-2376	14.95
HD0165	7.95
74C922	9.95

ICM CHIPS

ICM7045	$24.95
ICM7205	19.95
ICM7207	7.50
ICM7208	19.95
ICM7209	6.95

NMOS READ ONLY MEMORIES

MCM6571	$13.50
MCM6574	13.50
MCM6575	13.50

TV GAME CHIP SET
AY-3-8500-1 Chip and 2.010 MH2 Crystal **$7.95**

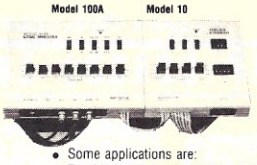
MISCELLANEOUS

11C90	$19.95	MK40240	$17.50
MC3061P	11.95	DS0026CH	3.75
MC1408L7	4.95	TIL308	10.20
MC1408L8	5.75	95H90	11.95
LD110/111	$25.00/set		
MC4016(74416)	7.50		
4N33	3.95		

PARATRONICS Logic Analyzer Kit Model 100A

$229.00/kit

Model 100A Model 10



- Analyzes any type of digital system
- Checks data rates in excess of 8 million words per second
- Trouble shoot TTL, CMOS, DTL, RTL, Schottky and MOS families
- Displays 16 logic states up to 8 digits wide
- See ones and zeros displayed on your CRT, octal or hexadecimal format
- Tests circuits under actual operating conditions
- Easy to assemble — comes with step-by-step construction manual which includes 80 pages on logic analyzer operation.

(Model 100A Manual - $4.95)

- Some applications are:
  - — Troubleshooting microprocessor address, instruction, and data flow
  - — Examine contents of ROMS
  - — Tracing operation of control logic
  - — Checking counter and shift register operation
  - — Monitoring I/O sequences
  - — Verifying proper system operations during testing

PARATRONICS TRIGGER EXPANDER - Model 10

Adds 16 additional bits. Provides digital delay and qualification of input clock and 24-bit trigger word. — Connects direct to Model 100A for integrated unit).

Model 10 Kit - $229.00
Baseplate — $9.95
Model 10 Manual — $4.95

B&K PRECISION 3½-Digit Portable DMM

- Overload Protected
- .3" high LED Display
- Battery or AC operation
- Auto Zeroing
- 1mv, 1Va, 0.1 ohm resolution
- Overange reading
- 10 meg input impendence
- DC Accuracy 1% typical

Ranges: DC Voltage ±0-1000V/ AC Voltage: 0-1000V
Freq. Response: 50-400 HZ
DC/AC Current: 0-100mA
Resistance: 0-10 meg ohm
Size: 6.4" x 4.4" x 2"

Model 2800 $99.95
Comes with test leads, operating manual and spare fuse.

Accessories:
AC Adapter BC-28 $9.00
Rechargeable Batteries BP-26 20.00
Carrying Case LC-28 7.50

CSC 100 MHz 8-Digit Counter

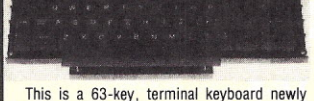
- 20 Hz-100 MHz Range
- .6" LED Display
- Crystal-controlled timebase
- Fully Automatic
- Portable — completely self-contained
- Size — 1.75" x 7.38" x 5.63"
- Four power souces, i.e. batteries, 110 or 220V with charger 12V with auto lighter adapter and external 7.2-10V power supply

MAX-100 $134.95

ACCESSORIES FOR MAX 100:
Mobile Charger Eliminator use power from car battery — Model 100 — CLA $3.95
Charger/Eliminator use 110 V AC — Model 100 — CAI $9.95

KEYBOARDS

63-Key Unencoded | Hexadecimal Encoder



This is a 63-key, terminal keyboard newly manufactured by a large computer manufacturer. It is unencoded with SPST keys, unattached to any kind of PC board. A very solid molded plastic 13 x 4" base suits most application. IN STOCK **$29.95/each**

19-key pad includes 1-10 keys, ABCDEF and 2 optional keys and a shift key. **$10.95/each**

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets — 25¢
1978A Catalog Available—Send 35¢ stamp

NEW NAME

Jameco ELECTRONICS
a division of JAMES ELECTRONICS of California

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE
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J1

The Incredible "Pennywhistle 103"

$129.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications for the deaf. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method .....Frequency-Shift Keying, full-duplex (half-duplex selectable).
Maximum Data Rate.....300 Baud
Data Format .....Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies ...2025 Hz for space; 2225 Hz for mark.
Transmit Channel Frequencies ..Switch selectable: Low (normal) = 1070 space, 1270 mark; High = 025 space, 2225 mark.
Receive Sensitivity.....-46 dbm accoustically coupled.
Transmit Level .....-15 dbm nominal. Adjustable from −6 dbm to −20 dbm.
Receive Frequency Tolerance ...Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface.....EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements .....120 VAC, single phase, 10 Watts.
Physical.....All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

The Original the 3rd Hand

$9.95 each

- *Leaves two hands free for working
- * Clamps on edge of bench, table or work bench
- * Position board on angle or flat position for soldering or clipping
- * Sturdy, aluminum construction for hobbyist, manufacturer or school rooms

DIGITAL STOPWATCH

- Bright 6 Digit LED Display
- Times to 59 minutes 59.59 seconds
- Crystal Controlled Time Base
- Three Stopwatches in One Times Single Event — Split & Taylor
- Size 4.5" x 2.15" x .90" (4½ ounces)
- Uses 3 Penlite Cells.

Kit — $39.95
Assembled — $49.95
Heavy Duty Carry Case $5.95

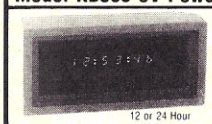
Stop Watch Chip Only (7205) $19.95

IMC 3½ DIGIT DPM KIT

- New Bipolar Unit
- Auto Zeroing
- .5" LED
- Auto Polarity
- Low Power
- Single IC Unit

Model KB500 DPM Kit $49.00
Model KB503 5V Power Kit $17.50

JE700 CLOCK



The JE700 is a low cost digital clock, but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6" x 2½" x 1". It utilizes a MAN72 high brightness readout, and the MM5314 clock chip.

12 or 24 Hour

115 VAC *KIT ONLY* **$16.95**

JE803 PROBE

The Logic Probe is a unit which is for the most part indespensible in trouble shooting logic families TTL, DTL, RTL, CMOS. It derives the power it needs to operate directly off of the circuit under test, drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols (H) - 1 (LOW) - 0 (PULSE) - P. The Probe can detect high frequency pulses to 45 MHz. It can t be used at MOS levels or circuit damage will result.

$9.95 Per Kit
printed circuit board

T²L 5V 1A Supply

This is a standard TTL power supply using the well known LM309K regulator IC to provide a solid 1 AMP of current at 5 volts. We try to make things easy for you by providing everything you need in one package, including the hardware for only. **JE225 $9.95 Per Kit**

CSC PROTO BOARDS

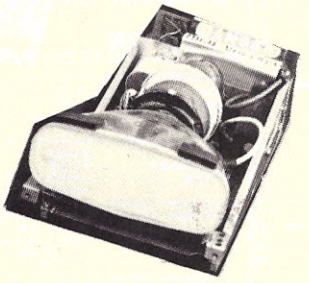
PROTO BOARD 6
$15.95
(6" long X 4" wide)

PB100 - 4.5" x 6"	$ 19.95
PB101 - 5.8" x 4.5"	29.95
PB102 - 7" x 4.5"	39.95
PB103 - 9" x 6"	59.95
PB104 - 9.5" x 8"	79.95
PB203 - 9.75 x 6½ x 2¾	80.00
PB203A - 9.75 x 6½ x 2¾ (includes power supply)	129.95

PROTO CLIPS

14 PIN	$4.50
16 PIN	4.75
24 PIN	8.50
40 PIN	13.75

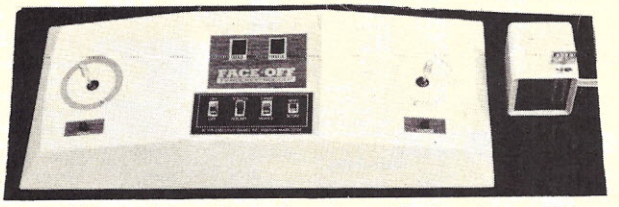
TYPESETTING MONITOR



We have acquired an unusual video monitor. It was originally designed for and used in the photo typesetting industry. As the typesetter composed his copy, the copy would appear on the screen. The tube is a flat type about 6½" x 2¼", since only one line of copy was scanned at a time. Most of the tubes have slight burn marks, but are still usable. We have all the circuitry, and will supply the circuitry with each order. We believe most of these units are in working order, since they were taken out of service when the equipment was upgraded. Looks like a good start to make into your own video monitor at giveaway prices. We have them with and without the CR tubes. Sold as is only.

STOCK No. 5603K Typesetter monitor with tube & circuit diagrams . . . . . $22.50 ea. 2/$40.00
STOCK No. 5604K Typesetter monitor without tube, with circuit diagrams . $15.00 ea. 2$25.00

TV HOCKEY and SOCCER GAME plus VIDEOCUBE

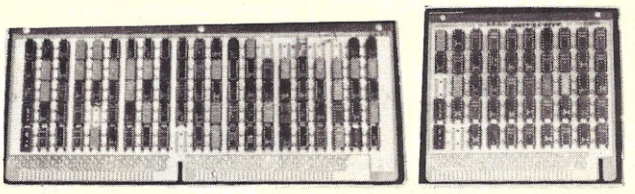


For some time we have been selling our VIDEOCUBE, the TV interface between computers, cameras, etc., and your TV set. We sold them in kit form, and to date we have sold over 3,000. We sold the complete VIDEOCUBE, when available, for $16.95.

We now have a limited number of Hockey-Soccer Video games, complete with VIDEOCUBE interface, at a new low price of $18.95; previously sold for $27.50 in kit form. This gives you two games, at two levels of skill, with LED readouts for scorekeeping. This game sold in Boston department stores for $79.50.

STOCK No. 5495K Complete VIDEO GAME & VIDEOCUBE $18.95 ea. 2/$35.00

WIRE WRAP BOARDS LOADED WITH 7400 SERIES ICs



Since last summer, we have been selling 2 wire wrap boards, Our Stock No. 6558K with approximately 100 sockets, and our Stock No. 6559K with approximately 45 sockets. These have been successful, based on your orders and reorders. We now have the same boards, but with the sockets still containing the original SN7400 series ICs that were used in the computer that these boards were designed for. We checked the value of these ICs, against the lowest price ICs in several Electronics magazine, and found that at the lowest possible surplus prices, the values of the ICs on the 100 socket board ran to over $40.00. A sample of some of the chips on the board we looked at are as f ollows: 74H87, 7486, 74107, 7451, 7400, 7404, 7495, 7493, 7492, 74193, 7489 and many others, to numerous to mention. Also on some boards, are a few linears, and phase locked loops. Not everyone needs every chip, but if you are working at all with TTL, this is a great opportunity to get an inventory of the most useful chips at a ridiculous price. We are selling the 100 socket board with about 100 chips, for $10.00 more than the board itself, and the 45 socket chip for $5.00 more than the board itself. We will also include with each board, 2 edge connectors with the 100 socket board, and 1 edge connector with the 45 socket board.

STOCK NO.6558K	75 to 100 socket board	$18.75 ea. 2/35.00
STOCK NO.6559K	45 to 50 socket board	$11.75 2/22.00
STOCK NO.6749K	75 to 100 socket wire wrap board with ICs and edge connectors	$28.75 ea. 2/55.00
STOCK NO.6750K	45 to 50 socket wire wrap board with ICs and edge connector	$16.75 ea. 2/32.00
STOCK NO.6603K	Edge connector for either board	$ 2.00 ea 3/5.00

MORE NEW TRANSFORMERS

TRANSFORMER 1. Primary 115 V, Secondary 1, 30V @ 2 A.Secondary 2, 16.5 V @ 1.2 A. Secondary 3, 16 V @ 3.5 A. Secondary 4, 9.5 V @ 3.5 A.

STOCK NO.6677R Wt. 10 lbs. $10.95 ea. 2/20.00

TRANSFORMER 2. Primary, 115 V. Secondary 1, 12 V. @ 5 A., Secondary 2, 24 V. @ 9 A., Seconday 3 14 V. @ 20 A. Secondary 4, 125 V. @ 1.5 A.

STOCK NO.6675K 16 lbs. 18.95 2/36.00

TRANSFORMER 3. Primary 115 V. Secondary 1, 12.6 V ct @ 1 A.Secondary 2, 33 V tapped at 13.1 V @ 1 Amp. Secondary 3, 140 V. @ 100 ma.

STOCK NO.6772K 2 lbs. 4 1/16"x 2 1/16"x 2 5/8". 2.95 ea. 2/5.00

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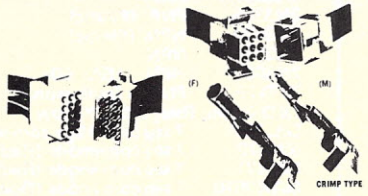

NYLON CONNECTORS

Complete Connectors Per Pkg.	Type No.	Class	Description	Mfg by Molex Price Ea. Pkg.
5	1625-1PRT	Min.(.062")	1 Circuit	$1.75
3	1625-2PRT	"	2 Circuit	1.90
3	1625-3PRT	"	3 Circuit	2.10
2	1625-4PRT	"	4 Circuit	2.10
2	1625-5PRT	"	5 Circuit	2.20
2	1625-6PRT	"	6 Circuit	2.35
1	1649-8PRT	"	8 Circuit	1.55
1	1625-9PRT	"	9 Circuit	1.75
1	1625-12PRT	"	12 Circuit	1.90
1	1625-15PRT	"	15 Circuit	2.30
1	1625-24PRT	"	24 Circuit	3.25
1	1772-36PRT	"	36 Circuit	4.55
5	1619PRT	Std.(.093")	1 Circuit	1.75
3	1545PRT	"	2 Circuit	1.90
3	1396PRT	"	3 Circuit	2.10
2	1490PRT	"	4 Circuit	2.10
2	1653PRT	"	5 Circuit	2.20
2	1261PRT	"	6 Circuit	2.35
1	1292PRT	"	9 Circuit	1.80
1	1360PRT	"	12 Circuit	1.90
1	1375PRT	"	15 Circuit	2.45

Prototype hand tools combine efficiency with economy. Ideal for prototype or limited production runs.
HT-1919 for .093" pin dia. terminals ..... $8.95 each
HT-1921 for .062" pin dia. terminals ..... $8.95 each

Econo-Extractor removes terminal from nylon connector housing with smoothness and ease.
HT-2054 for extracting .093" pin dia. terminals ..... $2.25 each
HT-2023 for extracting .062" pin dia. terminals ..... $2.25 each

Deluxe ejector tools, spring-loaded for simple, efficient removal of terminal from nylon connector housing-extracts either male or female terminals of same pin diameter.
HT-2038 for extracting .093" pin dia. terminals ..... $6.70 each
HT-1010-282 Replacement tip for HT-2038 ..... $2.50 each
HT-2285 for extracting .062" pin dia. terminals ..... $6.70 each
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555 Timer 8 pin mini-DIP	.49
741 Compensated OP-Amp 8 pin DIP	.37
LM 1889N RF Video Modulator	7.45
CA3130 Bipolar/Mos-FET Op Amp	1.19
CA3140 MOS-FET Op Amp, Bi-polar out	.99
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LM3911 Temp Control CHIP	1.50
Signetics 2504TA 1024 bit S.R. memory (1404A)	$1.75
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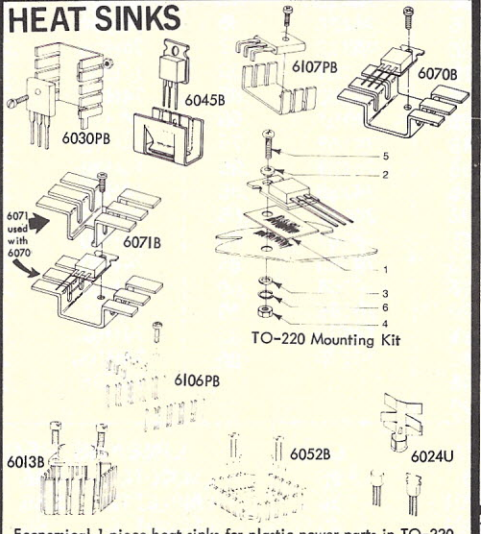
DATA AQUISITIONS SUBSYSTEM
ADC0817 is a 40 pin CMOS I.C. with an 8-bit analog-to-digital converter, a 16 channel multiplexer and micro processor compatible control logic. Converter features high impedance chopper stabilized comparator, voltage divider with analog switch tree and a sucessive approximation register. Latched Tri-State outputs for easy u-processon interface. Require only 15 mW of power from single 5V supply. Fast, 100uS conversion time.
ADC0817.....(40 pin DIP).....$29.88
Spec sheets.....$1.00

Annie Sez,

If you've been studying to find a better source for your electronic parts, enroll in TRI-TEK. We're a degree better!

HEAT SINKS



Economical 1 piece heat sinks for plastic power parts in TO-220 and Motorola cases 77, 90, 199, and TO-126. All are black anodized aluminum. "B" series is anodized after forming. "PB" series is anodized prior to forming.

THM 6030PB	Vertical	25¢, 5/$1.00, 10/$1.90
THM 6045B	Slip Over	30¢, 4/$1.00, 10/$2.00
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TO-220 6 Piece Mounting Kit - Handy Package...25¢

P. C. BOARD TERMINAL STRIP
Molded body encloses postive screw activated clamp which will accomodate wire sizes 14-30 AWG. Contacts and pins are solder plated copper. Pins are on .200 inch (5.08mM) for standard P. C. mounting. 10Amp rating. Compare our prices before you buy.

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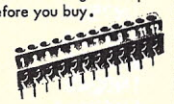

S-100 BUS CONNECTORS (IMSAI TYPE)
Gold, Solder tail for Mother boards $4.50,4/$17.00
Tin-Nickel, (NASGLO) Solder tail $3.75,4/$14.00
Gold, wire-wrap.....$4.50,4/$17.00
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HEX DARLINGTON ARRAY
MCI4I3P is a 16 pin DIP package with (6) 50V 500mA Darlington pairs.
MCI4I3P.....$1.59
Specs/Apps.....30¢

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Lo Profile Tin Solder Tail Dip Sockets

8 pin	10/$1.50	100/$14.00	1000/$120.00
14 pin	10/$1.70	100/$16.00	1000/$140.00
16 pin	10/$1.90	100/$18.00	1000/$160.00

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7805-06-08-12-15-24 TO220	95¢ 5/$4.50
7905-06-08-12-15-24 TO 220	95¢ 5/$4.50
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Lm317K 1.5A *Adjustable* TO-3	4.99
Lm317T 1.5A *Adjustable* TO-220	3.99
Lm317MP .5A *Adjustable* TO-202	13.95
TL430C Adjustable Zener-*Think About It*	1.50
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ADJUSTABLE NEGATIVE REGULATOR
LM337 is the compliment to the popular LM317 positive adjustable regulator. Capable of 1.5Amp from - 1.2V to - 37V.
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—Free Wire with any Wrap Tool —	
Miniature Square .05/100V Monolithic Cap	10/2.00
FND5002 .125" C.C. 7 Seg. Read-out	.49¢,10/$3.95
2N4036 90V, 1A PNP Silicon TO-5	.50
2N6101 80V, 10A NON HI GAIN TO-220	.50
6.3 VCT, 1.2A Transformer F41X	2.49
12V, 1A Transformer with 6' Power Cord	2.88

Jumper Kits for .025 Square Posts.. All material for making jumpers for quick circuit changes and proto-typing. Use for breadboarding, trouble shooting, field modifications. Fits standard IC socket wire/wrap posts. Excellent wiping action on gold plated box contacts. Kit contain 10 box contacts, heat shrinkable sleeving, and 5 feet of wire plus instruction sheet.
JCK-5101....(5 double jumpers)$2.75, 4 kits/$10.00

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- Orders less than $10 ($15 foreign) please add $1 handling.
- Prices are subject to change without notice.
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Charge card telephone orders ($20 min.) will be accepted 9-5:30 P.M. except weekends. Telephone 995-0352. No collect calls please.

T1

DIODES/ZENERS

1N914	100v	10mA	.05
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

SOCKETS/BRIDGES

8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
16-pin	pcb	.25	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.10
28-pin	pcb	.35	ww	1.45
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Molex pins .01		To-3 Sockets	.45
2 Amp Bridge		100-prv	1.20
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2N2222A	NPN (2N2222 Plastic .10)	.15
2N2907A	PNP	.15
2N3906	PNP (Plastic)	.10
2N3904	NPN (Plastic)	.10
2N3054	NPN	.35
2N3055	NPN 15A 60v	.50
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4012	.20
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4015	.90
4016	.35
4017	1.10
4018	1.10
4019	.50
4020	.85
4021	1.00
4022	.85
4023	.25
4024	.75
4025	.30
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.50
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	.95
4044	.95
4046	1.75
4049	.45
4050	.45
4066	.95
4069	.40
4071	.35
4081	.70
4082	.45
MC 14409	14.50
MC 14419	4.85

– T T L –

7400	.15	7473	.25	74176	1.25	74H72	.45	74S133	.40
7401	.15	7474	.30	74180	.75	74H101	.75	74S140	.55
7402	.20	7475	.35	74181	2.25	74H103	.75	74S151	.30
7403	.20	7476	.40	74182	.95	74H106	.95	74S153	.35
7404	.15	7480	.55	74190	1.75			74S157	.75
7405	.25	7481	.75	74191	1.05	74L00	.25	74S158	.30
7406	.35	7483	.95	74192	.75	74L02	.25	74S194	1.05
7407	.55	7485	.75	74193	.85	74L03	.30	74S257 (8123)	1.05
7408	.25	7486	.25	74194	1.25	74L04	.30		
7409	.15	7489	1.35	74195	.95	74L10	.30	74LS00	.25
7410	.10	7490	.55	74196	1.25	74L20	.35	74LS01	.35
7411	.25	7491	.95	74197	1.25	74L30	.45	74LS02	.35
7412	.30	7492	.95	74198	2.35	74L47	1.95	74LS04	.30
7413	.35	7493	.35	74221	1.00	74L51	.45	74LS05	.45
7414	1.10	7494	.75	74367	.85	74L55	.65	74LS08	.25
7416	.25	7495	.60			74L72	.45	74LS09	.35
7417	.40	7496	.80	75108A	.35	74L73	.40	74LS10	.35
7420	.15	74100	1.15	75110	.35	74L74	.45	74LS11	.35
7426	.30	74107	.35	75491	.50	74L75	.55	74LS20	.25
7427	.45	74121	.35	75492	.50	74L93	.55	74LS21	.25
7430	.15	74122	.55			74L123	.85	74LS22	.25
7432	.30	74123	.55	74H00	.15			74LS32	.40
7437	.30	74125	.45	74H01	.25	74S00	.35	74LS37	.35
7438	.35	74126	.35	74H04	.20	74S02	.35	74LS40	.45
7440	.25	74132	1.35	74H05	.20	74S03	.30	74LS42	1.10
7441	1.15	74141	.90	74H08	.35	74S04	.30	74LS51	.50
7442	.45	74150	.85	74H10	.35	74S05	.35	74LS74	.65
7443	.65	74151	.65	74H11	.35	74S08	.35	74LS86	.65
7444	.45	74153	.75	74H15	.45	74S10	.35	74LS90	.95
7445	.65	74154	.95	74H20	.30	74S11	.35	74LS93	.95
7446	.95	74156	.95	74H21	.25	74S20	.35	74LS107	.85
7447	.95	74157	.65	74H22	.40	74S40	.20	74LS123	1.00
7448	.65	74161	.85	74H30	.20	74S50	.20	74LS151	.95
7450	.25	74163	.85	74H40	.25	74S51	.25	74LS153	1.20
7451	.25	74164	.60	74H50	.25	74S64	.20	74LS157	.85
7453	.20	74165	1.50	74H51	.25	74S74	.35	74LS164	1.90
7454	.25	74166	1.35	74H52	.15	74S112	.60	74LS367	.75
7460	.40	74175	.80	74H53J	.25	74S114	.65	74LS368	.75
7470	.45			74H55	.20			74C04	.25
7472	.40							74C151	2.25

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9301	.85	95H03	1.10
9309	.35	9601	.45
9322	.75	9602	.45

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8038	3.95	LM320T12	1.65	LM340K18	1.25	LM725N	2.50
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LM301	.45	LM324N	.95	78L05	.75	LM741 (8-14)	.25
LM308 (Mini)	.95	LM339	.95	78L12	.75	LM747	1.10
LM309H	.65	7805 (340T5)	.95	78L15	.75	LM1307	1.25
LM309K (340K-5)	.85	LM340T12	1.00	78M05	.75	LM1458	.95
LM310	1.15	LM340T15	1.00	LM373	2.95	LM3900	.50
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LM320K5 (7905)	1.65	LM340K12	1.65	LM711	.45	NE556	.95
LM320K12	1.65					NE565	.95
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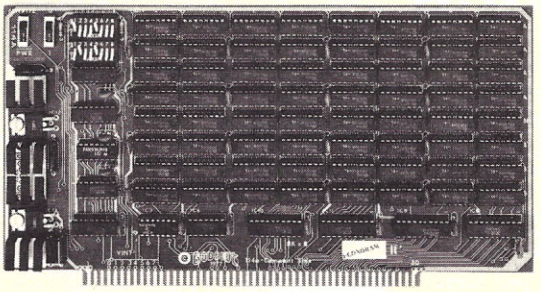
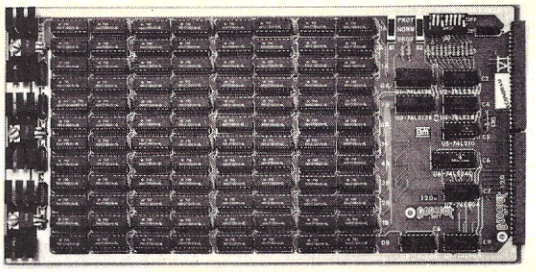


OUR BEST SELLER: ECONORAM II™

S-100 Compatible 8K × 8 in a cost-effective package. Buffering on all lines, 0 wait states with the 8080, low power consumption, configured as two separate 4K blocks for addressing flexibility, handles DMA, memory protect with vector interrupt provision if you try to write into protected memory, fully socketed, gold-flashed edge fingers, solder masked and legended board . . . this is the board that doesn't cut any corners, but cuts the price instead.

(See the 1/77 issue of **Kilobaud** magazine for a product profile that tells just about everything you'd ever want to know about Econoram II . . . or send a self-addressed, stamped envelope to "Kilobaud Article" c/o our address and we'll send you a reprint. But if you **really** want to be convinced . . . talk to somebody who owns one!)

Kit form: $135.00 3 kits: $375.00 Assembled, tested: $155.00



SUPER MEMORY FOR A SUPER MACHINE: H8 COMPATIBLE ECONORAM VI™

Users of the S-100 buss have found out why our memories are their best value . . . now H8 owners can find out too. This 12K × 8 kit offers the same basic features as our ECONORAM series . . . static design, configuration as two blocks (one 8K and one 4K), switch selected protect, sockets for all ICs, full buffering on address and data lines . . . plus the required hardware and edge connector to mate mechanically with the H8. As a bonus, **all** sockets and bypass capacitors are pre-soldered to the circuit board so you can start right in on the fun part of building this high-quality memory.

Kit form: $235.00

NEW! 16K × 8 ECONORAM IV™ KIT

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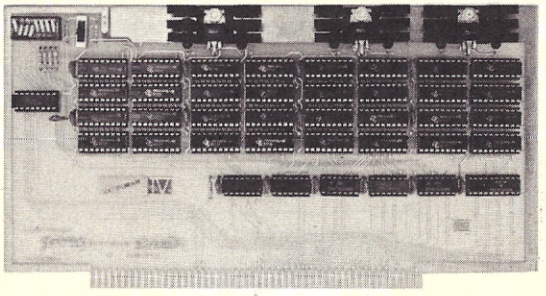

COMING SOON: 24K ECONORAM VII™ KIT

Just around the corner for your S-100 buss . . . we think you'll like it. While the price per bit is slightly higher compared to our other memories, you get some nice extras along with the regular Econoram features . . . such as the same current consumption as our 16K board, and some more switches and options. **It's static, it's 24K, it's an Econoram . . . watch for it!**

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10 SLOT MOTHERBOARD

Whether implemented as an add-on to existing systems that need more room, or as the nucleus of a stand-alone system, this S-100 compatible motherboard fits the needs of the budget-minded enthusiast. Our price includes **all** edge connectors, along with active termination circuitry that promotes accurate and reliable data transfer. Lots of bypass caps and extra heavy power line traces contribute to efficient operation. Heavy duty epoxy glass board, with a solder mask for easy soldering.

#CK-015, $90.00. Kit form only.

18 SLOT MOTHERBOARD

All the same features and advantages of the 10 slot version, including our active termination circuitry. Complete with 18 edge connectors.

#CK-016, $124.00. Kit form only.

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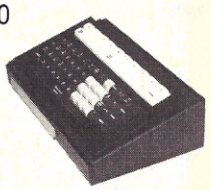

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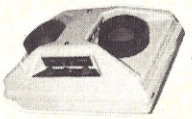

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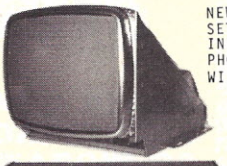

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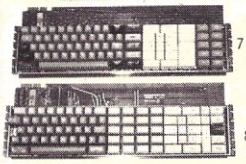

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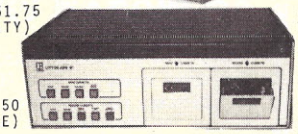

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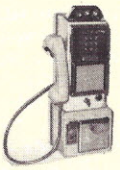

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+5	12.6	RTL	B312	$65	+6	5.0	RN	5451	$29
+5	13.0	RTE	B314	$62	+13.5KV	.31MA	RN	5356	$14
+5	16.0	RTL	B315	$82	+10 TO +20	1.5	RNPV	5311	$25
+5	20.0	RTL	B316	$95	+90	1.0	XN	5154	$14
+5	31.0	RTL	B317	$135	+24	20	XN	B332	$48
+5	24.0	RTL	B318	$98	+4.25	150	RNEH	B336	$137
+5	32.5	RTE	B319	$138	+12,-12	5.0			
+5	74.0	RTP	B320	$198	-36	1.0			
+5	74.0	RTL	B321	$198	+4.6 TO6.8	0-70	RTV	B338	$195
+12	2.5	RTL	B323	$21	+12 TO +15	.4	RTL	B339	$23
+12	5.0	RN	B324	$38					
+12	7.3	RTL	B325	$44					
+12	10.0	RTL	B327	$75					
+12	10.5	RTE	B328	$65					
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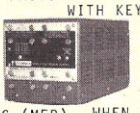

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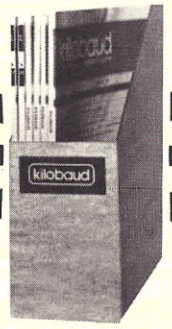

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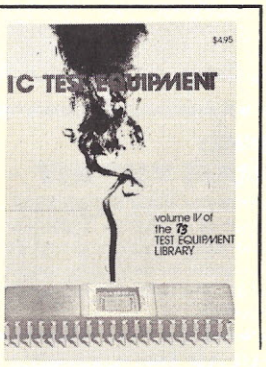

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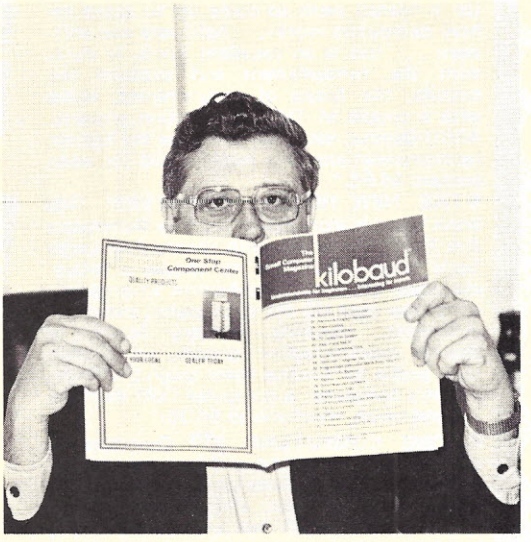
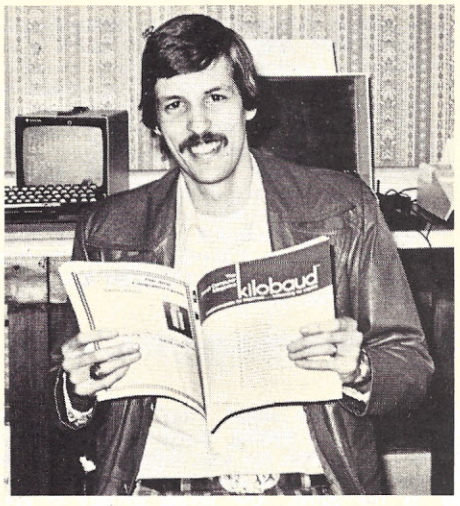
WHO'S BEHIND THE kilobaud™?

This chap behind the Kilobaud is the driving force behind a new microcomputer system . . . using the 6100. Does that give it away? Watch out for the dealer network he's getting together.



LAST MONTH'S MYSTERY READER



Last month's "Who's Behind the Kilobaud" was Steven Pereira, president of the Microcomputer Store in Nashua. Nashua now has three-going-on-four computer stores, which is remarkable considering its size. New Hampshire's freedom from a sales tax, which saves substantial dollars on a computer system, is drawing many companies to Nashua. Among the many new factories put in recently were a couple by DEC.

READ IT YOURSELF!

If you are not yet a subscriber to Kilobaud, we need you and you need us. There is a lot of data in Kilobaud that you will want to have on hand . . . the magazine is like a continuing encyclopedia of microcomputing and programs. You never know when you are desperately going to need something from a past issue . . . and you'll want it immediately. The cost per year is not significant . . . $15 at present for $24 worth of magazines.

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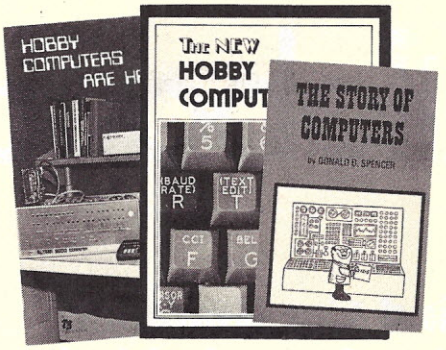

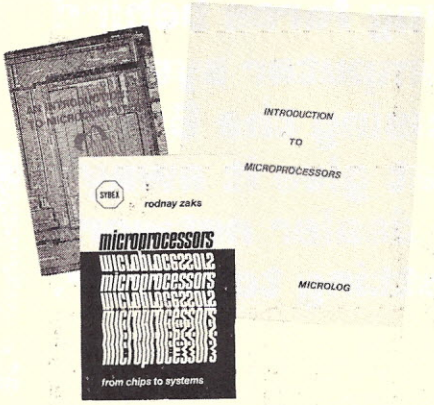

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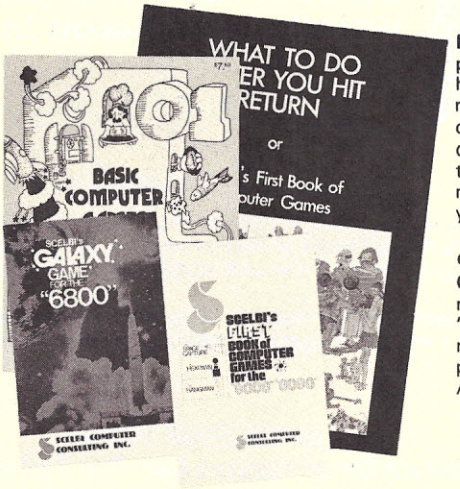

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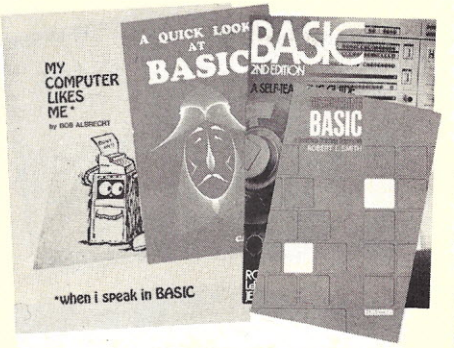

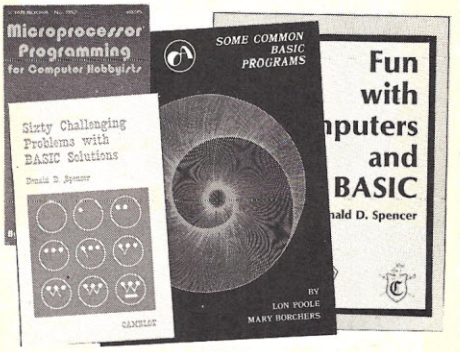

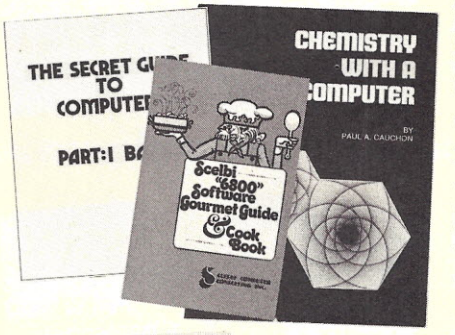

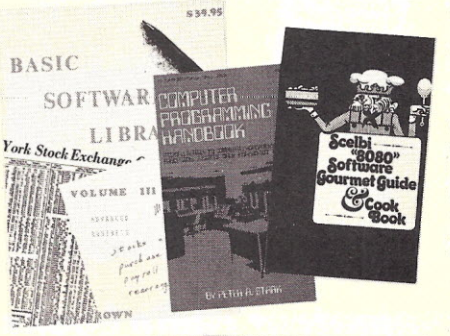

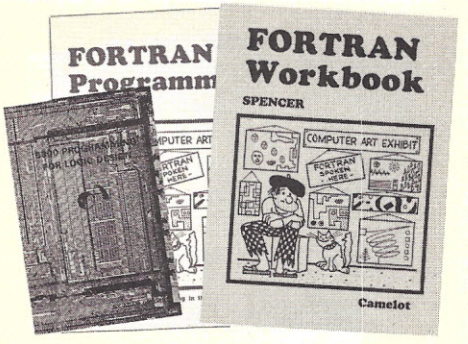

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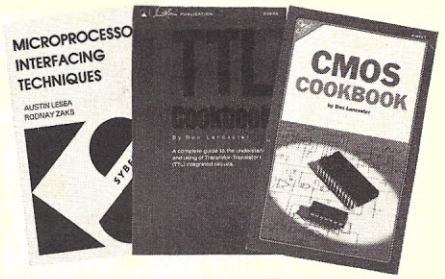

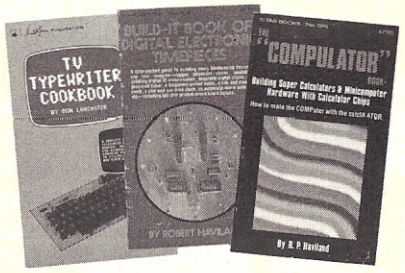

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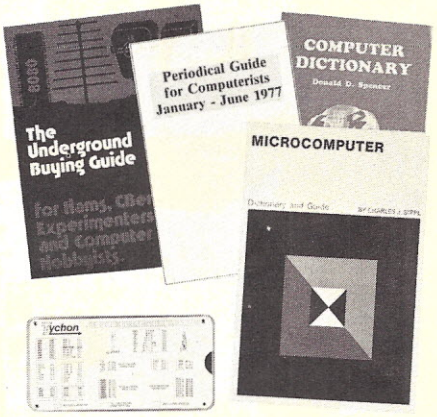

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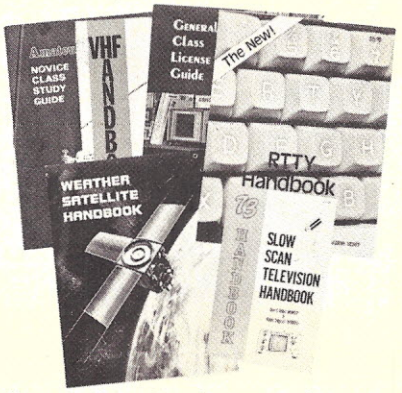

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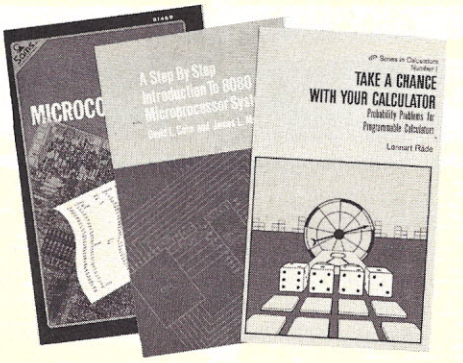

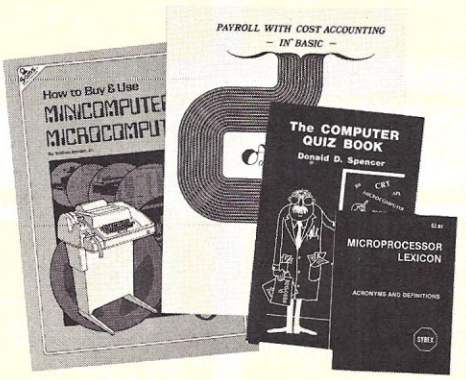

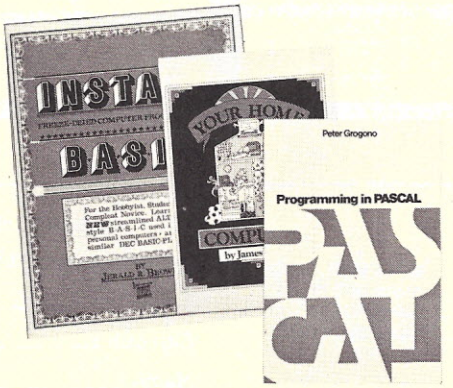

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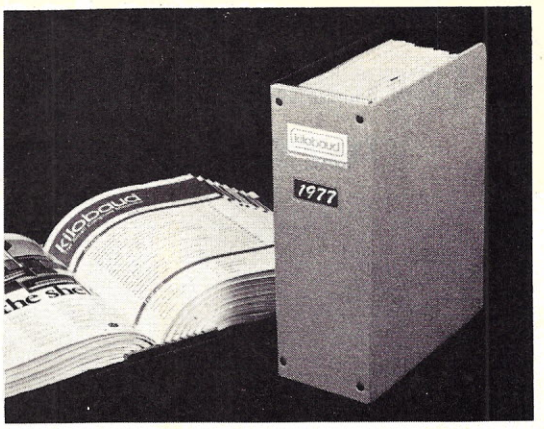

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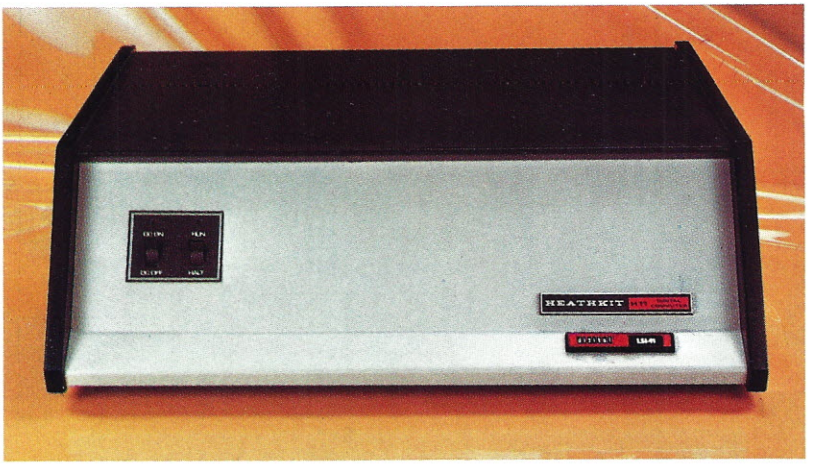

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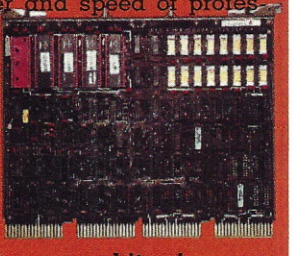

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